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HEATING AND VENTILATING

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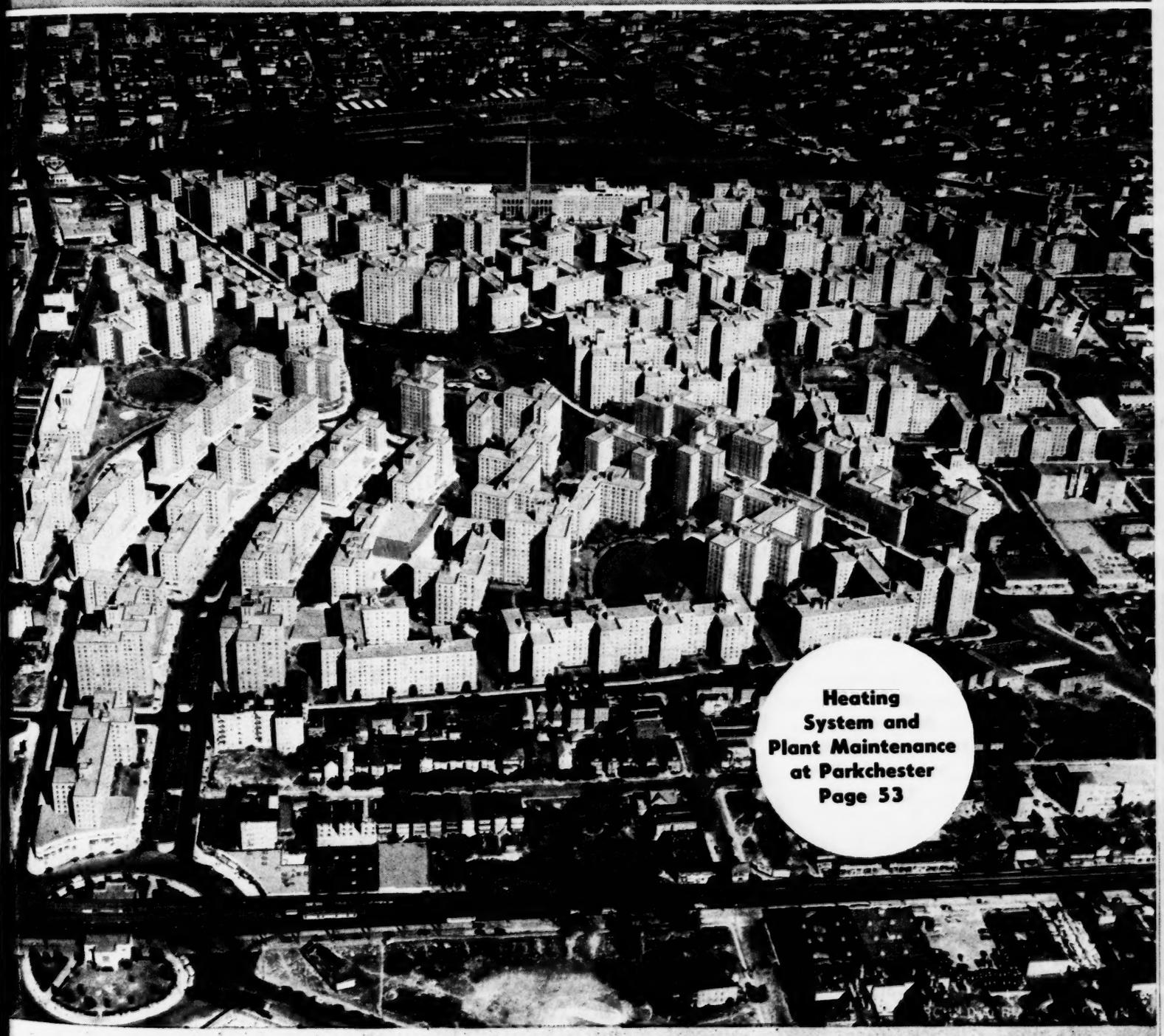

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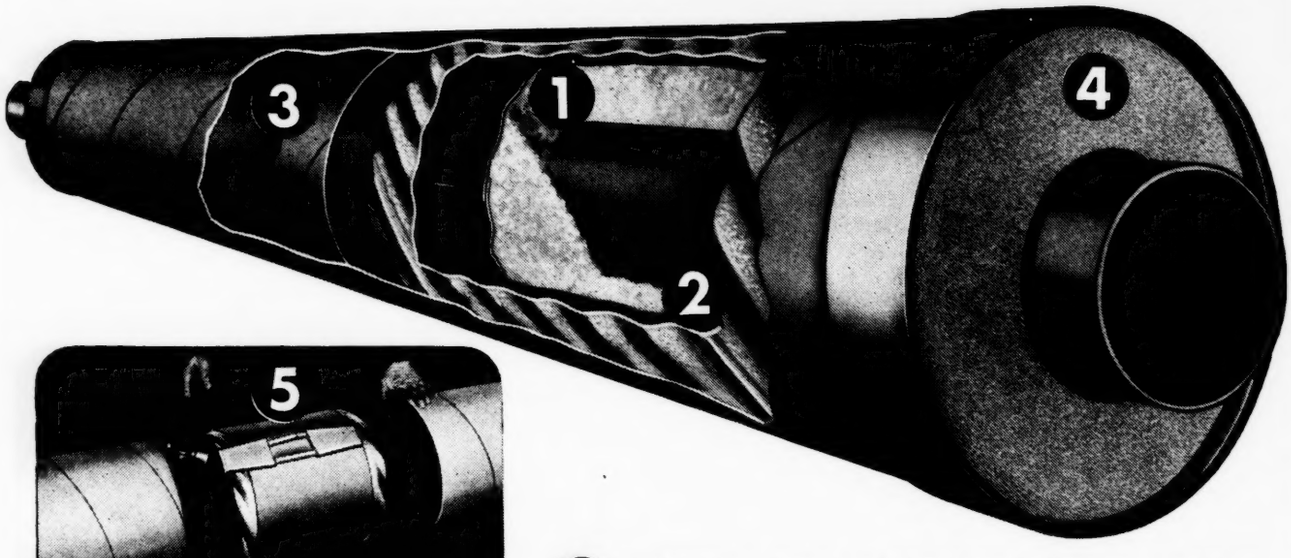
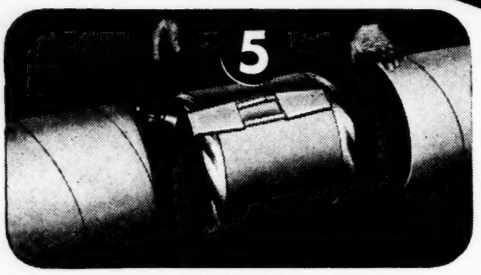
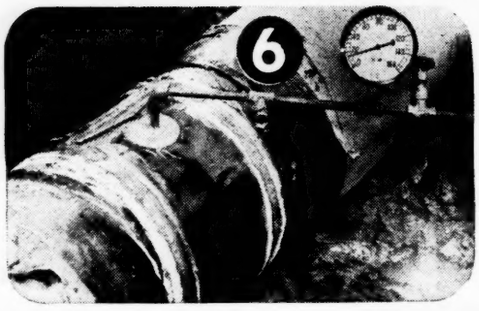
RIC-WIL







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VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, AIR SANITATION, PIPING, HEATING AND VENTILATION

Published by

THE INDUSTRIAL PRESS
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Publishing Information

HEATING AND VENTILATING is published monthly by The Industrial Press at 148 Lafayette Street, New York 13, N. Y. Yearly subscription in the United States, Spain, South America, Mexico, and Canada, $2.00; in all other countries, $3.00. Single copies 30 cents. Entered as second class matter, April 18, 1925, at the Post Office, New York, N. Y., under the act of March 3, 1879.

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THIS MONTH'S COVER

Air view of Parkchester showing central heating plant with its stack in the distance. Maintenance methods for the project are described beginning page 53. Photo by Fairchild Aerial Surveys.

TRANE

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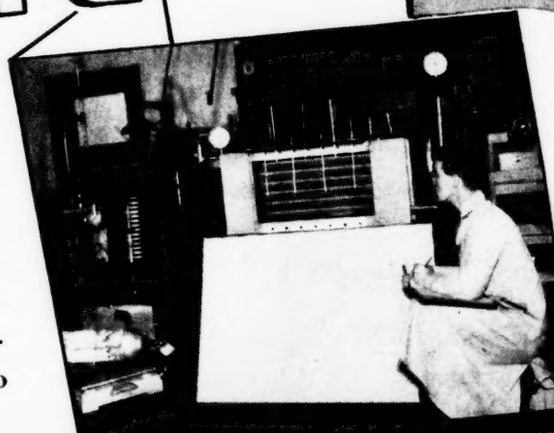

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More than 200 Trane field engineers in principal cities all over the country co-operate with architects, engineers, and contractors in the application of Trane systems. National advertising is advising customers to seek counsel and Trane information from architect, engineer, and contractor.

Washington News

LORING F. OVERMAN

Construction Ban Modified.
Material for Veterans' Housing.
Price Control Lifted.
Revolt Against OPA.
Export Rules Tighter.

WASHINGTON news continues to be the local news for everyone in a business or profession. April proved no exception, for out of the nation's capital came numerous developments of either direct or implied value to those in the heating, ventilating and air-conditioning industries. Among them should be included:

Tempering of the construction ban to provide a more logical balance between veterans' housing and other building essential to a sound economy.

Amendment of Priorities Regulation No. 33 to channel additional material into low-cost veterans' housing and to broaden the list of projects and individuals eligible for priorities assistance.

Release of hundreds of items of capital equipment from OPA price ceilings, including much heating, ventilating and air-conditioning equipment.

Passage by the Senate of the Wagner-Taft-Ellender permanent housing bill and the house-approved Patman emergency housing bill, with amendments.

Passage by the House of the OPA extension bill, with cripping amendments.

Imposition of export controls on scarce products, including heating, ventilating and air-conditioning equipment.

Building Ban Tempered

The milder attitude of the Civilian Production Administration in regard to construction of types other than housing for veterans is expressed in a statement of policy released (on April 12) by CPA to its 71 field offices. The statement explains that a sound economy is vital to the success of the veterans' housing program, and that as a result, certain necessary new construction activities will be permitted to go forward side by side with veterans' housing.

To be eligible for approval, projects must meet a double test of essentiality and non-deferrability. Even though a project may be voted essential, it may be considered as deferrable if there are sufficient facilities available to meet current needs.

To be considered essential a project must be intended: For the production of a product declared critical by CPA; to eliminate a local shortage of employment opportunities amounting to a community hardship; to eliminate a serious shortage of an essential activity or service affecting the general health, safety or welfare of a community; or to eliminate a reconversion bottleneck.

The yardstick of deferrability is less definite. Regulations state that an essential project will be considered deferrable "if the service or production is already being provided even though on a limited scale." "On the other hand," the policy statement continues, "a project may be considered non-deferrable if it is to provide essential production or service not presently being provided, or being provided only on such a limited scale that it is a general hardship to the community."

Another interesting phase of the instructions to field offices is the clause referring to hardship cases. "A project may be recommended for approval," the instructions provide, "in cases where a denial would work a rare and unusual hardship *on the applicant*, as distinguished from community hardship, even though the case does not otherwise meet the criteria of essentiality and/or deferrability."

Although the instruction concludes with the comment that all considerations of deferrability of essential projects must hinge on the impact of the proposed project on the veterans' housing program, it may be generally concluded that a great deal of commercial and industrial building that appeared doomed under the initial version of the Veterans Housing Order will probably be continued or resumed. This will prove doubly true if materials used are not of the types required for housing.

Rental Construction Encouraged

Another change noted in administration of the veterans' housing program is the stress being placed upon multiple-unit rental housing. Reports received from many large cities indicate an increasing interest in large-scale rental projects—just the type in which the products and services of readers of this column will be employed—according to Wilson W. Wyatt, National Housing Expeditor.

"The need for rental housing cannot be underestimated, so we intend to give all possible encouragement to the construction of apartment buildings, large and small," said Mr. Wyatt. "They not only will provide the type of housing many veterans need but the large projects will furnish jobs to types of workers who are not generally employed on small home construction.

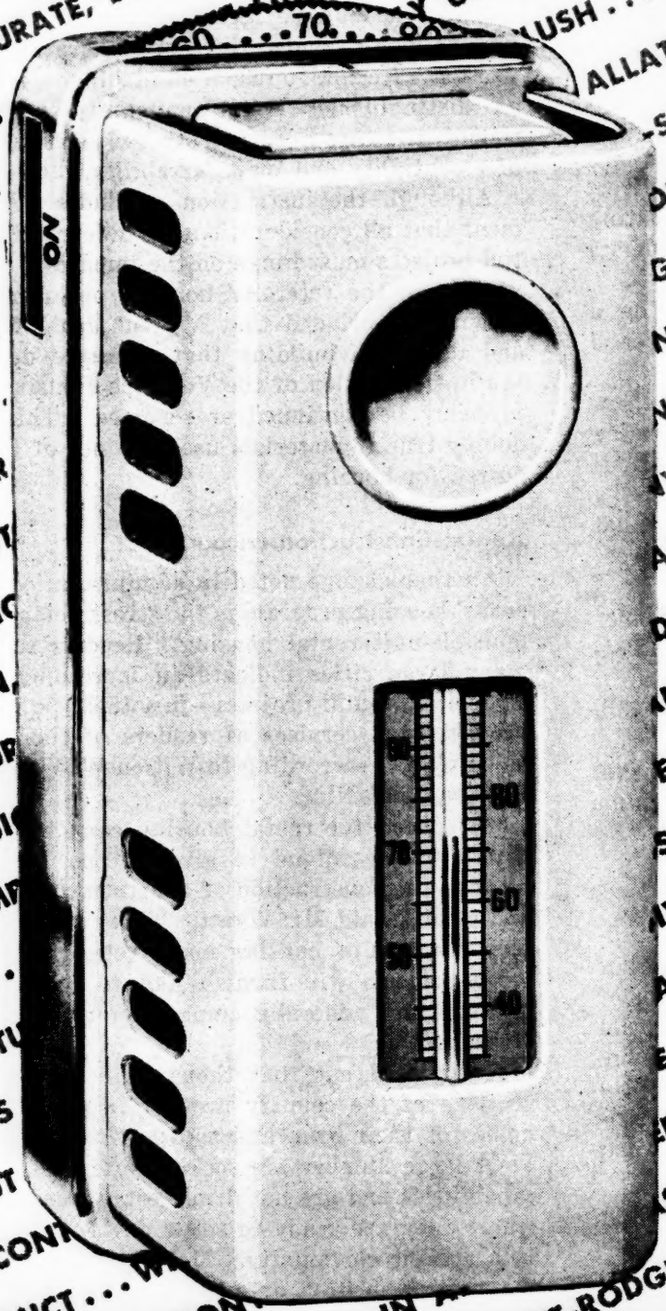
He pointed out that thousands of veterans in all sections of the country are not in a position to buy homes of their own, and said:

"A large number are seeking jobs best fitting their capabilities and are not firmly established to the point where they are ready to settle down to a lifetime job in a specific community. Many of them are completing their education or embarking on their first jobs, and consequently do not wish to be tied down by an investment in a permanent home."

Materials Earmarking

Earmarking of nearly 50% of all scarce building materials for veterans' housing projects is expected to be one of the primary results of the amendment of

Built to be INSTALLED and then FORGOTTEN



NO MATTER which of the controls in the complete White-Rodgers line you use, their many exclusive features are designed to relieve you of any future attention. Years of satisfactory service have proved the dependability of White-Rodgers Hydraulic-Action controls.

Priorities Regulation No. 33. (April 12). The regulation, issued last December in an effort to channel materals into homes costing less than $10,000, initially earmarked approximately 35% of available materials into the low price veterans' housing field. Expansion of this to 50% is expected to follow broadening of the eligible list to include several service-connected classes of applicants. The order has also been changed to provide HH priority ratings for materials needed for buildings for family occupancy, farm houses, including bunk houses for temporary farm labor, apartment hotels which are not primarily for transients, and dormitories or group housing accommodations put up by educational or public institutions for veterans.

It should be noted that the National Housing Agency now has authority over applications for priorities assistance under PR-33 for almost all kinds of non-veteran as well as veterans' housing, and for authorization to do housing construction, repair or alteration which would otherwise be prohibited under Veterans' Housing Program Order 1. The authorization, and HH priorities are issued through the state and district offices of a Federal Housing Administration, a unit of the National Housing Agency. Non-housing applications are to be filed with Civilian Production Administration field offices.

Price Ceilings Dropped

Accepting many of the recommendations of the Machinery and Allied Products Institute, the OPA has issued Amendment 13 to Supplementary Order 129, suspending price control on a long list of machines, parts, industrial materials and services. Copies of the amendment, which lists scores of items of interest to producers of heating, ventilating and air-conditioning equipment, may be secured by writing to Distribution Section, Office of Price Administration, Washington 25, D. C. Of direct interest are the following excerpts from the Amendment:

Section 12 (c) is amended by adding the following products (to the list exempted and suspended from price control):

Air preheaters, economizers and superheaters designed and sold for use with steam generating equipment described in paragraph (c) of the amendment.

Burners, gas, industrial, designed for use with products covered by RMPR 136.

Burners, oil, industrial and marine, burning No. 5 oil or heavier, except rotary and gun-type burners under MPR 591.

Instruments, mechanical, for indicating, measuring, testing and/or recording (all types covered by RMPR 136).

Pulverizers, coal, including burners and auxiliary combustion equipment, installed for primary purpose of pulverizing solid fuel for firing any type of furnaces and which are required to be built to the National Bureau of Fire Underwriter Standards.

Regulators and dampers, power-operated.

Soot blowers and tube cleaners, power-operated, industrial and marine.

Steam generating equipment, such as industrial power boilers 100 p.s.i. and higher, for stationary and marine use, including water tube boilers, horizontal return tubular boilers, refractory lined fire box boilers, but not including steel heating boilers as defined in Section IV A3ME Boiler Construction Code such as horizontal fire box boilers, Scotch type boilers for stationary use, vertical tube and tubeless boilers, oil country type boilers and miniature boilers.

Stokers, industrial and marine, with feeding capacity of 1200 lb per hour or more.

Thermostats, bi-metallic and bellows types, except those covered by MPR 591 or 188.

Added to Section 12 (d) of Supplementary Order 129 is the following suspension from price control:

Heating, lighting, ventilating and air-conditioning equipment.

The release of many items of industrial equipment from price control is being interpreted in Washington as a preliminary to a price increase of 10 to 20%; faster deliveries, and new and better machinery and devices. The release of heavy items from ceilings is also regarded as the beginning of the end of price control for producers' goods of all types.

Housing Bills Moving

During April the Senate passed two important pieces of housing legislation. It approved a strengthened version of the House-originated Patman Emergency Housing Bill and returned it to the conference committee for one more going-over before final ratification by both Houses of Congress. The Senate also passed and sent to the House the Wagner-Ellender-Taft permanent housing bill, which would make the wartime National Housing Agency permanent and give it funds for a wide variety of housing programs.

Nearest to passage is the Patman bill, the emergency housing measure, which is expected to emerge from conference in somewhat its present form, providing: Authority for the Housing Expeditor to issue directives to other executive agencies, including OES and OPA; price ceilings on new, but not existing homes; top priority for veterans in buying or renting homes built under the program; authority to increase government insuring of home mortgages up to $3.8 billion; premium subsidies of $600 million to producers of building materials; guaranteed markets for prefabricated homes meeting specific standards.

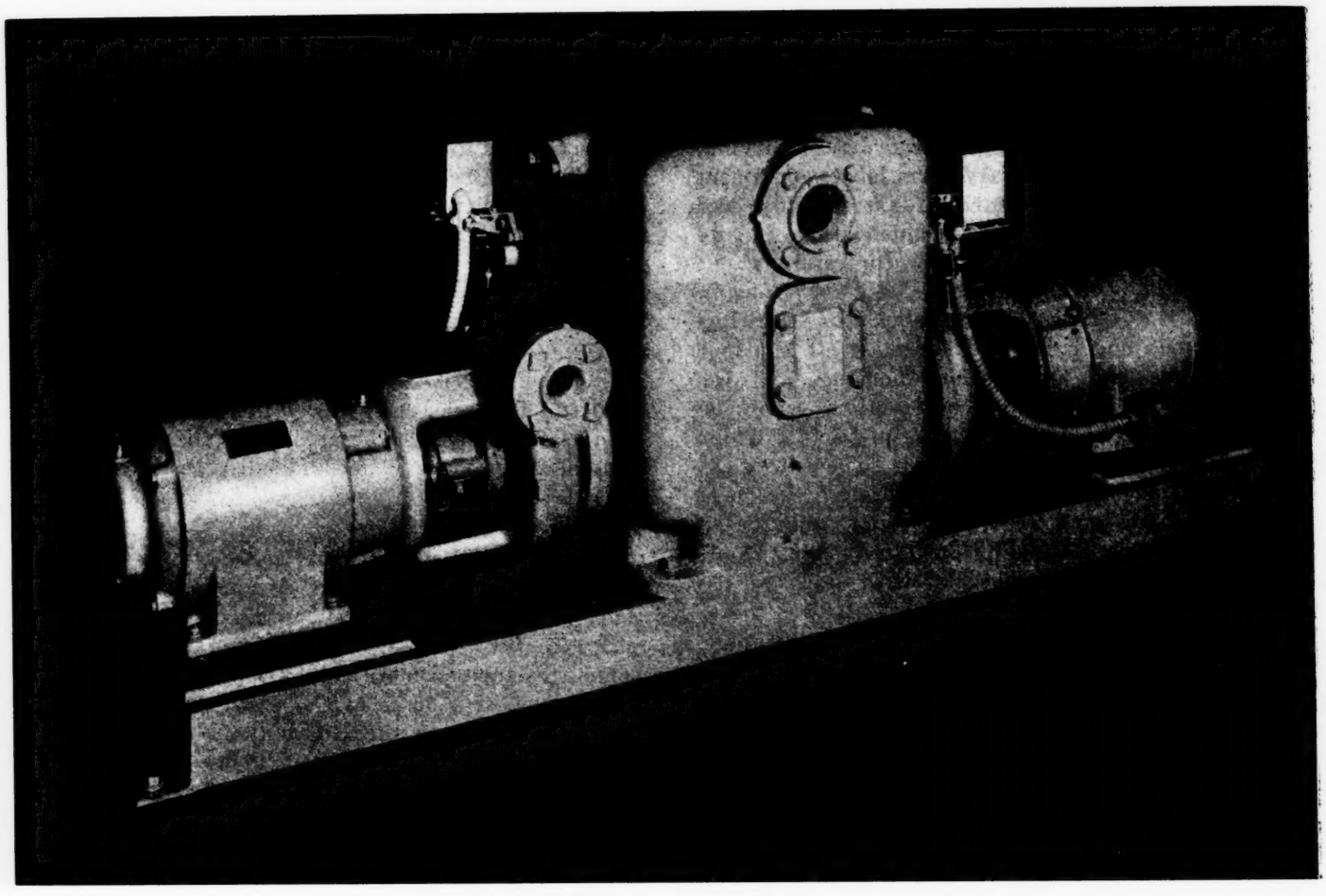
The Senate version of the Patman bill is more in line with Expeditor Wyatt's original estimate of what will be required to produce 2,700,000 homes for veterans in 1946 and 1947.

Still fought fiercely by private building interests is the Wagner-Ellender-Taft permanent housing bill, now awaiting hearings before the House Banking Committee. According to opponents, the bill "would greatly extend the area of government support and control of the home building and home financing industries and increase their dependence, as well as that of home buyers and home renters upon government benevolence. It would lay a firm foundation to continue in peacetime the programming and other controls developed as wartime measures. It is hard to imagine a measure which is more socialistic in its proposals than this one.

"Since this is a long-range housing measure and is

(Concluded on page 121)

MAXIMUM EFFICIENCY FOR STEAM HEATING SYSTEMS ON HEATING, DRYING AND PROCESS WORK.



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Designed for steam systems on heating, drying, or process work, these pumps offer the most reliable and efficient means of returning hot condensate to boiler or hot well. In many cases these pumps will save costly installation of boilers in a pit to provide gravity flow of returns from basement radiators and heating devices.

The Jennings Condensation Pumps are sturdy and compact in construction, and combine receiving tank, pump and driving motor in a single assembly. Pumps are bronze fitted throughout, with tobin bronze shaft. The pumping impeller is of special design, made possible by our wide experience with return line heating pumps, and is especially adapted for handling hot water with the greatest possible efficiency.

Full automatic control is furnished by means of a ball float and float switch mechanism mounted on the receiving tank. All wiring is made up at the factory, and it is necessary only to connect the pump to the system and hook up the leads. Complete information regarding these economical pumps sent promptly on request.

THE NASH ENGINEERING COMPANY

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Maintenance Methods at Parkchester

JOHN A. DONDERO

Chief Engineer, Parkchester, New York City.

Parkchester has been in operation for six years. During that time several methods have been tried and a plan developed for efficiently and effectively maintaining the heating system to the 51 buildings.

PICTURE a city within a city and you visualize Parkchester, a residential community built by the Metropolitan Life Insurance Company on 130 acres in the Bronx, New York City. It consists of 51 residential buildings with 12,272 apartments and a total of 42,457 rooms, 5 garages, a theater, 90 stores, a post-office, public library and 94 acres of lawns, recreational areas, gardens, paths and parkways.* During the six years this project has been in operation some interesting operating data have been obtained and some practical maintenance methods developed.

Steam for the entire community is generated in a central heating plant located at the north end of the development. The plant houses four Foster Wheeler D-type, water-tube boilers, each with a maximum generating capacity of 135,000 lb of steam per hour using oil, and 109,000 lb per hour when fired with pulverized coal. There is dual firing equipment and oil or coal may be burned separately or simultaneously, as conditions may warrant.

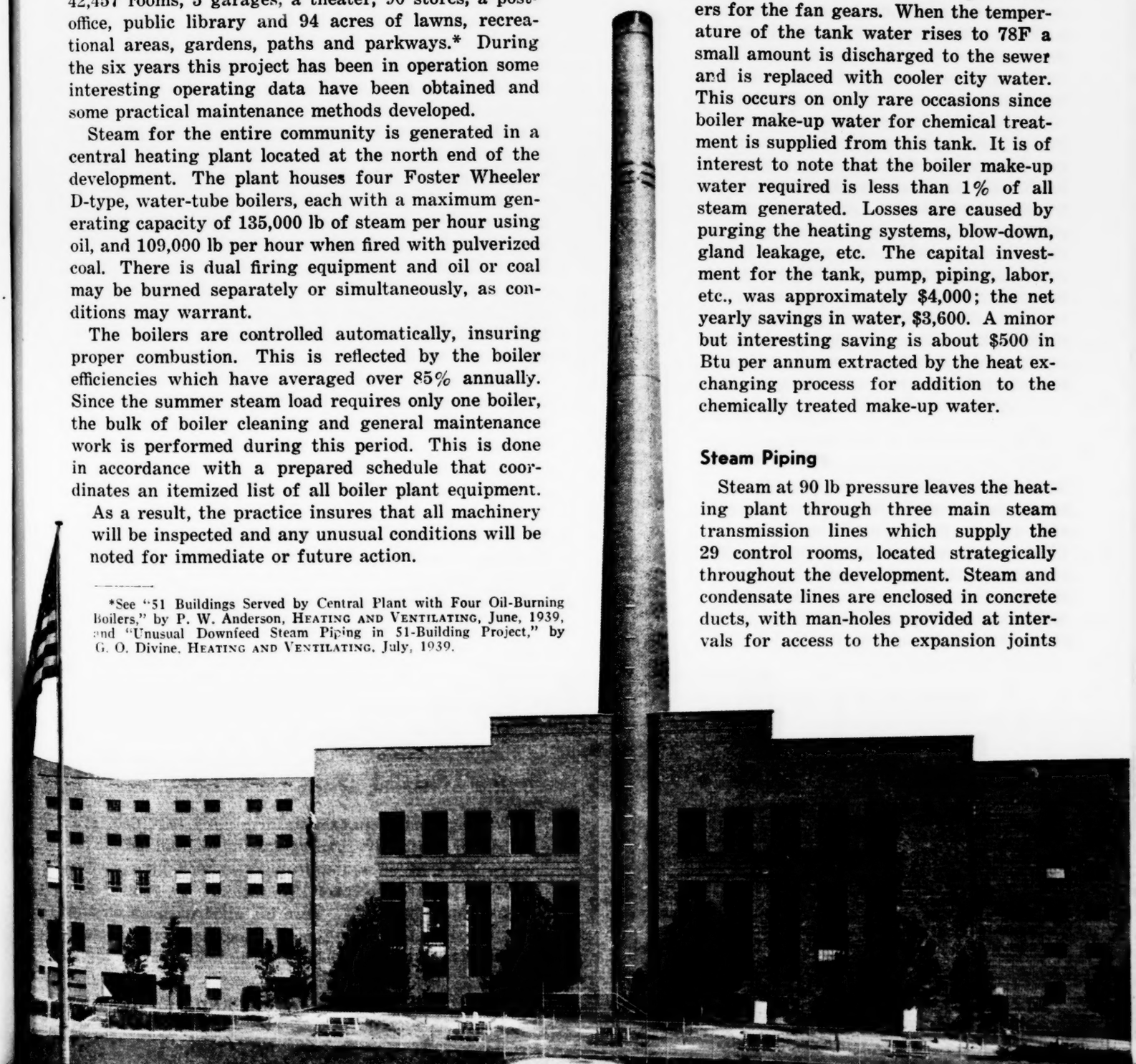
The boilers are controlled automatically, insuring proper combustion. This is reflected by the boiler efficiencies which have averaged over 85% annually. Since the summer steam load requires only one boiler, the bulk of boiler cleaning and general maintenance work is performed during this period. This is done in accordance with a prepared schedule that coordinates an itemized list of all boiler plant equipment. As a result, the practice insures that all machinery will be inspected and any unusual conditions will be noted for immediate or future action.

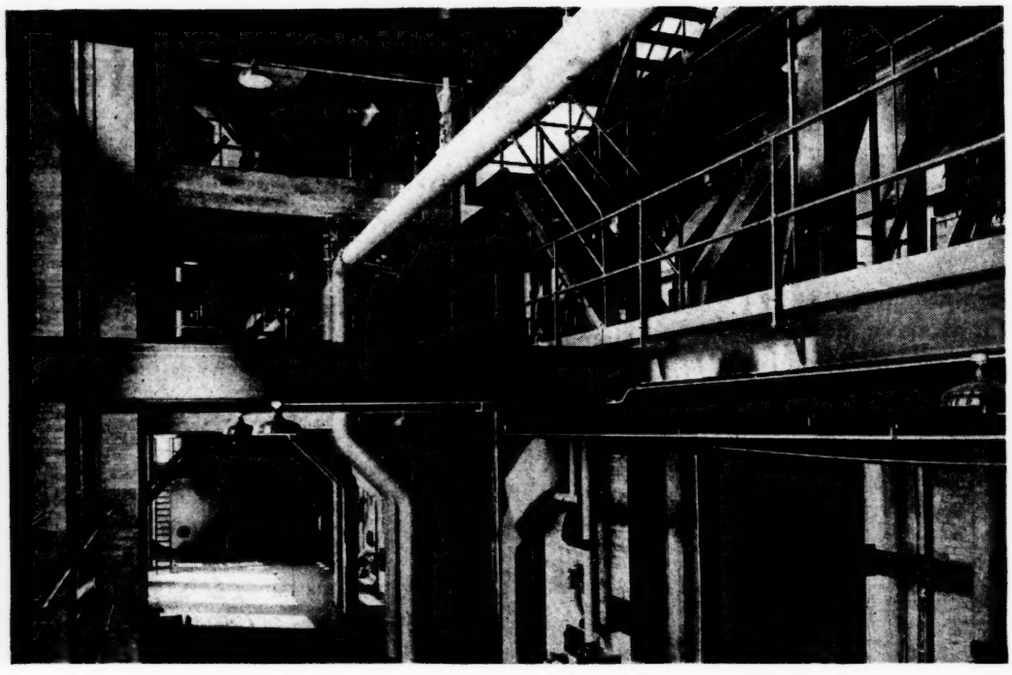
*See "51 Buildings Served by Central Plant with Four Oil-Burning Boilers," by P. W. Anderson, HEATING AND VENTILATING, June, 1939, and "Unusual Downfeed Steam Piping in 51-Building Project," by G. O. Divine, HEATING AND VENTILATING, July, 1939.

In the early stages of operation a mishap proved to be a later boon. A break-down in the city water supply system occurred, which affected a large area of the Bronx, threatened the plant with a water shortage. Steps were taken immediately to safeguard against a similar emergency. A steel water storage tank with a capacity of 30,000 gal was installed and this provides ample raw water supply for several days' operations. To realize the fullest economy from this investment, it was decided to install a circulating pump, and to use this tank water for cooling the jackets of the air compressors and the lubricating oil coolers for the fan gears. When the temperature of the tank water rises to 78F a small amount is discharged to the sewer and is replaced with cooler city water. This occurs on only rare occasions since boiler make-up water for chemical treatment is supplied from this tank. It is of interest to note that the boiler make-up water required is less than 1% of all steam generated. Losses are caused by purging the heating systems, blow-down, gland leakage, etc. The capital investment for the tank, pump, piping, labor, etc., was approximately $4,000; the net yearly savings in water, $3,600. A minor but interesting saving is about $500 in Btu per annum extracted by the heat exchanging process for addition to the chemically treated make-up water.

Steam Piping

Steam at 90 lb pressure leaves the heating plant through three main steam transmission lines which supply the 29 control rooms, located strategically throughout the development. Steam and condensate lines are enclosed in concrete ducts, with man-holes provided at intervals for access to the expansion joints

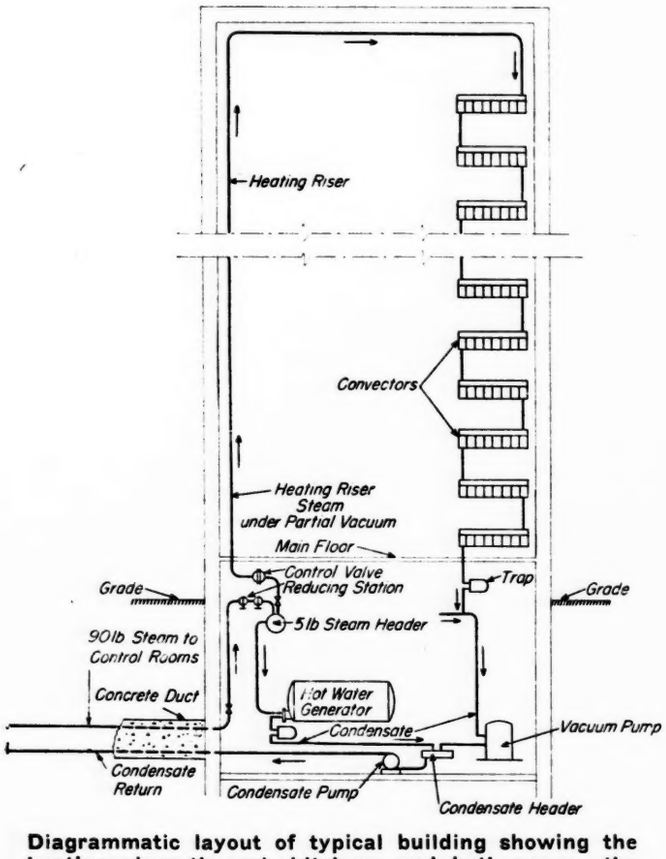




View of heating plant at rear of boilers showing the feed water deaerating heater and storage tank in the background.

and high pressure drip traps. These latter discharge to condensate headers in the control rooms and if a trap failure occurs it is observed at these points. An annual inspection is sufficient for the maintenance of traps.

Each of the 29 control rooms is equipped with steam reducing valves to provide 5 lb pressure; two hot water generators; hot water circulating, house, vacuum, condensate and sump pumps. Heating control panels are wall mounted and in some instances two or three buildings are operated from one of these central points.



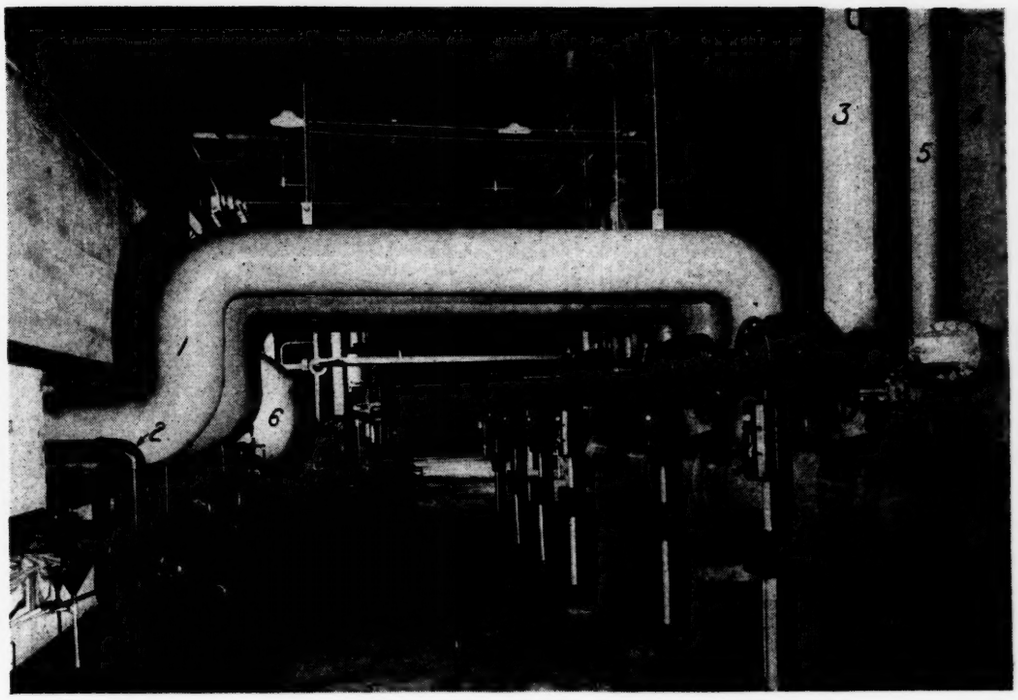
Diagrammatic layout of typical building showing the heating riser through kitchens and bath rooms, the convectors in living rooms and bed rooms, and the control room in the basement.

It may be of interest to study the physical layout of steam piping, for the convectors in the patented Metro system depart from the conventional plan. Steam supply risers pass upward through the kitchens and bathrooms and these uncovered pipes serve as space heaters. At the top floor, the pipe transfers at the ceiling to connect to convectors of adjacent living or bedrooms, as the case may be, and commences its descending run. In no case are valves or traps provided at convectors in typical apartments. In the basement, a float and thermostatic trap is provided at the heel of the last convector. With this type of installation many traps and valves were eliminated. By varying the vacuum within the heating system (which normally is carried at 25 in. of mercury in mild weather) consequently low steam temperatures are achieved, and complete thermostatic control effected with economy in operation and assured comfort for the tenants. The installation resulted in materially reducing maintenance costs and in assuring continuity of service.

The coordination of heating the 51 buildings with relation to heating plant operations was one of the first problems to be considered. It was determined that it would be most economical to operate only three boilers with the fourth as a stand-by. The average maximum load, occurring in the morning, was found to vary about 12% with its duration related to the temperature. It is of interest to note that the hot water load is normally simultaneous with the heating load, adding to the peak load on the boilers.

Control of Heating System

Heating control panels, as originally installed, provided for manually turning steam on and off. This was somewhat of a handicap as it took an operator 20 to 25 minutes to cover his stations. To reduce this differential, time clocks were installed with an on and off range of 8 to 10 minutes. This spread was sufficient for the three boilers to handle the load, and at night



View of the Heating Plant Basement. 1. Three main steam transmission lines. 2. Condensate return lines. 3.-4. Steam lines from boilers. 5. Auxiliary steam line. 6. Blow down tank. 7. One of row of electrically operated steam control valves. 8. Main steam header.

there was the added economy of steam being off the buildings simultaneously.

Heating equipment installed for the 51 buildings is the conventional Dunham differential vacuum system.

Trap Inspection and Testing

During the first two years of operation, it was necessary to clean, inspect, repair and test all thermostatic and float traps at least annually. At that time it was essential because of the large amount of mill scale, welding pellets, and dirt which was not eliminated despite a thorough flushing of the heating system piping by the contractor. During subsequent seasons, half of the traps were removed for checking and testing. This proved satisfactory for good operation. For purposes of identification, all traps are provided with a brass tag on which are stamped the building and trap number.

Three rooms have been equipped with steam, water and vacuum lines where heating system operating conditions may be simulated for repairs and testing of these traps. The trap manufacturer has provided gauges for setting the thermostatic elements and a supply of spare parts is always available. This painstaking care insures tightness and proper operation of traps, with subsequent economy in steam consumption and a minimum of heating troubles. The importance of this phase of maintenance is stressed. A final cold test is put on the piping system with the vacuum brought up to 19 to 20 in. The tolerance allowed is a loss of 1 in. of vacuum per hour and if this is exceeded the system is checked for the leak source.

All moving parts of vacuum pumps are given a very thorough check and nozzles are inspected for wear. Check valves are found a primary source of trouble both here and at all points of installation. It is found necessary to inspect and overhaul a large percentage each year.

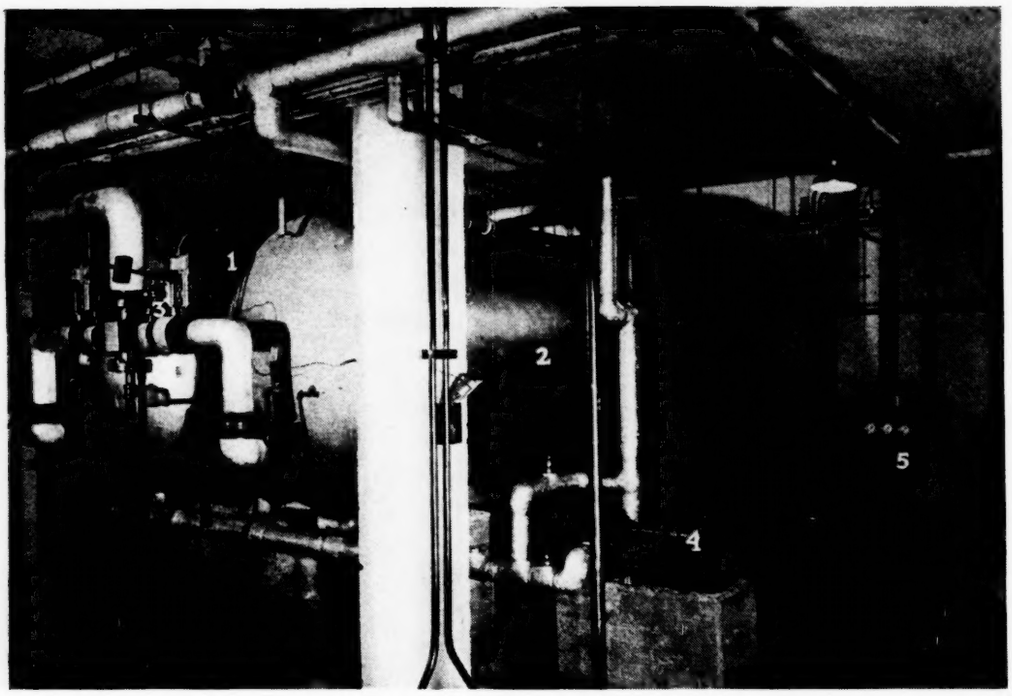
House, condensate and sump pumps are included in the annual maintenance schedule and the necessary packing of glands and repairs are made as inspections may indicate.

Turbidity and Corrosion

Turbidity control in the hot water system is very important and the tanks are blown down regularly. In addition, the flow of water through the circulating lines is accelerated and discharged directly to the sewer through an open funnel. Generally, this is done twice a month. The condition of the water as recorded determines the frequency of blowing down. The entire hot and cold water piping system is of brass, so the turbidity noted is not the so-called "red-water" attributed to ferrous piping, but is rather caused by the extraneous material introduced into the system by way of the water supply.

Corrosion in the piping systems, though hardly a routine maintenance problem, does have some relation

Water testing and control laboratory in the heating plant.



View of a typical control room. 1 and 2. Hot water generators. 3. Hot water temperature regulating valves. 4. Hot water circulating pumps. 5. Duplex vacuum pumps.

to it. Water and steam samples are analyzed daily by a chemist in a laboratory in the heating plant. These tests have been standardized for our needs and are of routine nature. Each year test pieces installed in the steam and condensate piping systems are removed for examination and their condition recorded. This is then compared with the previous year's record to determine if any progression of corrosive or galvanic action has taken place. In addition, six or eight sections of brass pipe are removed at random from the domestic water system for metallurgical study and report. These tests are made to anticipate and to control any inherent corrosive condition which may develop, thereby prolonging the life of these systems.

Cost and Economics

The problem of spare parts to be stocked was jointly studied by the respective manufacturers and the Parkchester staff. Each piece of equipment was carefully analyzed for expected life and vulnerability and from this the total quantity of parts to be inventoried was determined. A complete machine shop was provided with facilities for maintaining all mechanical equipment of the property.

All motors, electrical equipment and wiring are maintained by mechanics assigned from the Electrical Division, working in close co-operation with the mechanical group. Skilled attention to this important equipment insures a maximum safeguard against break-down and outage.

Guide for Operators

It was early recognized that a heating schedule for the watch engineers and operators was essential for proper operations and uniformity of service. This guide was prepared after a season's operations and in its final form provided the following information:

(a) It indicated when heat should be turned on or when it should be turned off.

(b) It provided for definite heating system pressures to be maintained with relation to the prevailing temperatures.

(c) Adherence to this schedule by the operators insured a constant room temperature of 72F, plus or minus 1F.

(d) During the spring and fall, when temperatures vary widely, it eliminated guesswork as to the course of action to be taken.

This guide has proven its worth during the past six years of operation and little revision has been required.

Important Factors

In summarizing the value of good maintenance and careful operations, cost is one of the most important gauges for the engineer in his program. While it is possible to over-maintain various pieces of equipment, carefully kept records and study should indicate the frequency and necessity of special maintenance work. Where the health or welfare of tenants in concerned, equipment that serves their needs should be given special consideration, as any break-down involving heating or hot water generation is a source of considerable trouble both to management and operations.

Steam consumption for the heating of apartments is one of the most important factors in determining the operation efficiency and maintenance policy. Figures for Parkchester indicate an average consumption for heating of 0.620 lb of steam per 1,000 cu ft of space per degree day. This average, however, would not ordinarily lend itself to easy comparison with other installations because of many variables to be considered. Some of the more important are: Type of heating system, equipment, age of equipment, construction of the building, occupancy, and temperature zone.

Case Studies Show Need of

Supply Air in Plant Ventilation

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Here is practical information on an often neglected phase of plant ventilation. Cases are cited to show what happens when too little thought is given to supply air and its mode of distribution.

INTEREST in the problem of supply air for industrial plants was initiated by the occurrence of a series of poisoning cases during winter months. In these instances, operations were not of such character as would ordinarily produce a hazard which could not be readily controlled. None of these plants had experienced any difficulty in the summer months.

It was found that in most plants there was an excellent system of general ventilation except that little provision was made to replace air which the fans were *trying* to remove. In some places it was found that the supply air was so limited that it seriously interfered with even the relatively low demands of local exhaust hoods. In the cases of old buildings where there is considerable leakage from the outside due to poor maintenance, it was common practice to shut off the exhaust fans during colder weather to reduce the heating load.

In general, we found the source of troubles encountered in the winter months resulted from a restricted ventilation rate produced by a lack of proper inlets for supply air. Apparently, there was a mistaken impression that, if the exhaust fans were operating, it would be possible to provide adequate ventilation with a greatly reduced heat load, if supply air was shut off.

The heating load was greatly reduced, of course, but the same effect could have been attained by merely shutting off the exhaust fans which would add a power saving to the reduced heat load. Many plant managers, however, believe that a rapidly revolving exhaust fan is essential to the safe operation of their plant, even though it moves little air. In some cases we were told that fans were merely for psychological purposes, the policy being to put in another exhaust fan whenever a complaint was registered.

The problem may be better appreciated by giving concrete examples of conditions that were found.

Poor Ventilation in Newspaper Plant

In a newspaper linotype room there were complaints of poor ventilation causing headaches and nausea. The linotype pots were gas-fired and mechanically exhausted. Two propeller fans were located in the roof. The only provision for make-up air was from windows, Fig. 1, located on one side of the room.

The linotype operators were seated close to the heated lead pots so that one side of their bodies was warmed. Any cold air admitted to the room was drawn toward the local exhaust hoods on their machines, producing drafts which caused the complaints. The proofreaders, who were women, were also seated and they were quite bitter about the cold drafts present.

In addition, there were many workers who brought the work to the linotype operators and removed the finished work and set it up into plates. These men, being younger and more active on their job, were continually complaining about the heat in the room and the lack of fresh air, while the others complained about the drafts.

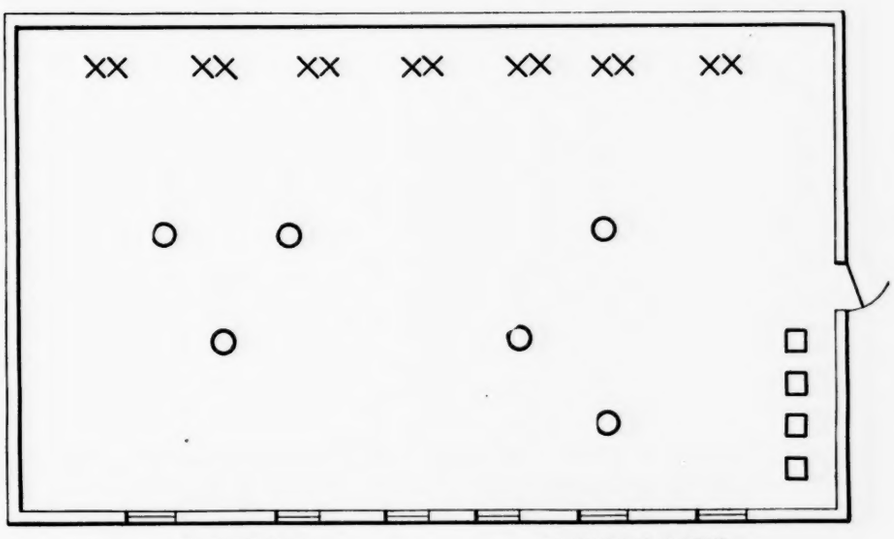

Fig. 1. Layout of linotype room.

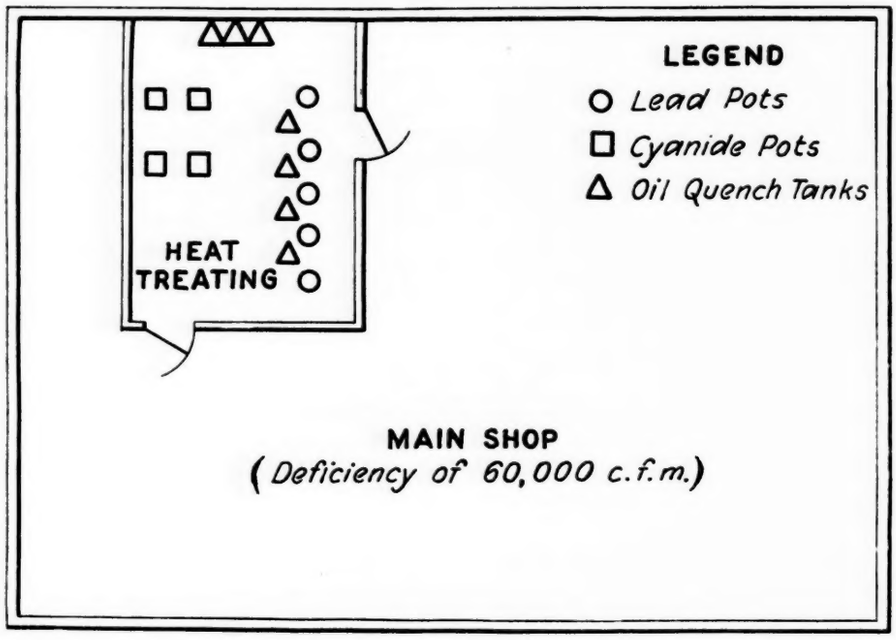

Fig. 2. Diagram of heat treating room.

Because of the complaints of the linotype operators about drafts, all of the general ventilation was shut off. Tests indicated that the linotype operators were exposed to lead and carbon monoxide in amounts above the maximum allowable concentrations. The excessive concentrations were due to a failure of the hoods caused by the restricted supply air. The control measures were obvious. The proofreaders should be moved out of the room since the temperature conditions and the noise and confusion interfered with their ability to concentrate on their work.

The linotype operators should also be isolated from the other workers by a partition. Fresh heated air should be provided to these workers, in excess of the amount required by the exhaust hoods on their machines. In this way when the doors were opened to their work area, there would be no surge of cool air to distract the men. This case illustrates the problem encountered wherever there are people doing jobs requiring different degrees of physical activity. In ordinary industrial heating this is a troublesome problem, but where there is a toxic hazard, the problem becomes acute when the situation is allowed to interfere with necessary ventilation.

Lead Fumes

The second case occurred in a plant where knives were being hardened by dipping them in molten lead and then in oil. Some of the tanks were "exhausted" by natural draft and some by exhaust fans. There were also two propeller fans for general ventilation. All workers showed high urinary lead excretion and several were hospitalized for plumbism. No provision was made for inlet air, Fig. 2, with the result that air was pulled down the natural draft stacks.

The main shop, which surrounded the hardening room, had a number of exhausted grinding wheels. In the winter, to lower the heating load, the inlet air was reduced so that there was a deficiency of 60,000 cfm in the main shop. The value of this is questionable since the exhaust on the grinding wheels simply was not doing an adequate job. A negative pressure was built up in the main shop so that when the doors to the hardening room were open (as was frequently required) air was pulled out of the hardening room. Instead of merely having a department operating with a deficiency of supply air, we had this department operating inside another room where there was an even greater deficiency of supply air. It was a vacuum within a vacuum.

The plant engineer had proposed to install centrifugal fans which would be powerful enough to build up a greater negative pressure in the hardening room than existed in the main shop.

Control measures which appeared to be more satisfactory and which were finally adopted are now described.

Exhaust from the grinding wheels was filtered and returned to the main shop, along with some heated make-up air. As contaminants were emery and steel dust, it was not difficult to reduce the dust count well below the maximum allowable concentration. This relieved the heat problem in the main shop and made it possible to maintain a slight pressure. A source of heated air was available for the hardening room by keeping the doors open at all times.

In the hardening room more efficient hoods were provided and all of the hoods had mechanical exhaust which made it possible to control easily the lead hazard. Total fan capacity of the new installation was not much greater than the original installation, but effective control was obtained because supply air was provided.

Lead Fumes in Foundry Air

In another case men were being hospitalized for metal fume fever. Urinary and atmospheric determinations indicated that the men were also being exposed to excessive lead concentrations. In the foundry where the cases occurred, it was difficult to open the door because of the negative pressure.

It was found that there was no provision for heating the air in the foundry and because of this the room was kept closed to keep the men warm. Several roof fans were building up a negative pressure, but were removing little air. As a temporary control measure the windows were opened during the pouring period when most of the contamination occurred. Only fans in the hoods over the furnaces were run during the molding period and enough air leaked into the room through the idle fans to ventilate the furnace area. Of course this was only a temporary measure.

The control consisted of supplying warmed air to the foundry for proper ventilation.

Objectionable Odors

In one plant complaints were received of headaches, dullness, loginess and inability to keep awake in a

modern windowless factory. No serious contamination was occurring in the plant. The carbon dioxide content of the air was above normal but this was not significant from a physiological standpoint. The carbon monoxide concentration was also not significant and no other contamination was apparent.

Plant officials maintained that the air in the plant was changed every 20 minutes. However, investigation showed that no fresh air supply was provided during the winter. This case was interesting because while it was obvious that the fresh air supply was limited, the cause of the dullness and drowsiness was not explained. The workers became hysterical and were afraid they were being poisoned by some insidious gas.

Temperature and humidity measurements revealed nothing significant. However, it was found with the Kata thermometer and heated anemometer that the air motion was very nearly zero. In addition, the odor of the small amount of air coming from the roof fans was decidedly unpleasant. Effects noted were caused by the shop odor due to body odors, heated rosin, oil fumes and other materials, none of which were toxic, but all very objectionable. This condition, while not obvious to the workers, was noticed by outsiders coming into the shop. Probably the most important factor was the lack of skin stimulation provided by moving air.

Very shortly we encountered similar conditions in three other plants where there were complaints of loginess and drowsiness. While no toxic material could be found, we did find stagnant air and appreciable odor. This odor was not noticed by the workers or by ourselves while in the plant, but it was evident by comparing the odor with fresh air. On the roof it was possible to detect the objectionable character of the odor from the exhaust equipment as compared to fresh air.

We believe in these cases the effect was produced either by the lack of air motion, which deprived the body of stimulation by moderate air currents, or the odor, although not recognized by the workers. It was recommended that at least 30 cfm of fresh warm air be supplied per worker.

Lacquer Fumes

One plant engaged in metal fabrication built a room 20 ft long, 15 ft wide and 12 ft high for the coating of small metal objects with lacquers. In order to prevent dust from entering the room, a positive pressure was maintained with two 24-in. fans by blowing air from an adjacent room. Self-closing louvers were installed in the same wall with the fans. Thus air was circulated between the two rooms. A hood was erected on the work table and was provided with a 5-in. pipe. One of the five girls applying the lacquer by brush worked at this bench. At the 3 ft x 2 ft face of the booth no appreciable velocity could be detected with the louvers open, while with the louvers closed velocities of 30-50 fpm existed.

A thorough study in the laboratory failed to reveal any especially toxic materials in the lacquers. Despite this the girls were subjected to headaches, loss of appetite, and nausea at night. The concentration of solvent vapors was barely perceptible and the consumption of solvent was so small that only very low concentrations in the air could be expected.

In making our ventilation measurements we soon noticed that the room was "stuffy." Since the fans were doing nothing but recirculating air, this was not surprising. The situation was remedied by installing four additional booths, and all five booths were provided with 7-in. pipes to the outside. Louvers were removed from the partition and the openings closed. Self-closing dampers were installed in the pipes leading outdoors. Thus, when the door to the room was open, a positive airflow outward minimized the entrance of dust. Provision was made to allow outside air to enter the fans. Under these conditions the workers experienced no distress.

Fan Size too Small

A battery of 30 gas-fired plastic molding machines located in the basement of a plant were found responsible for the evolution of objectionable smoke and fumes. Recognizing the undesirability of such a situation, the plant installed 10 axial-flow fans having a rated capacity of 52,000 cfm. A 3 ft by 2 ft duct was also installed to allow outside air to enter the room, but this was entirely inadequate. Unfortunately, the intake to this duct was located close to the discharge from a ventilation system exhausting grinding ma-

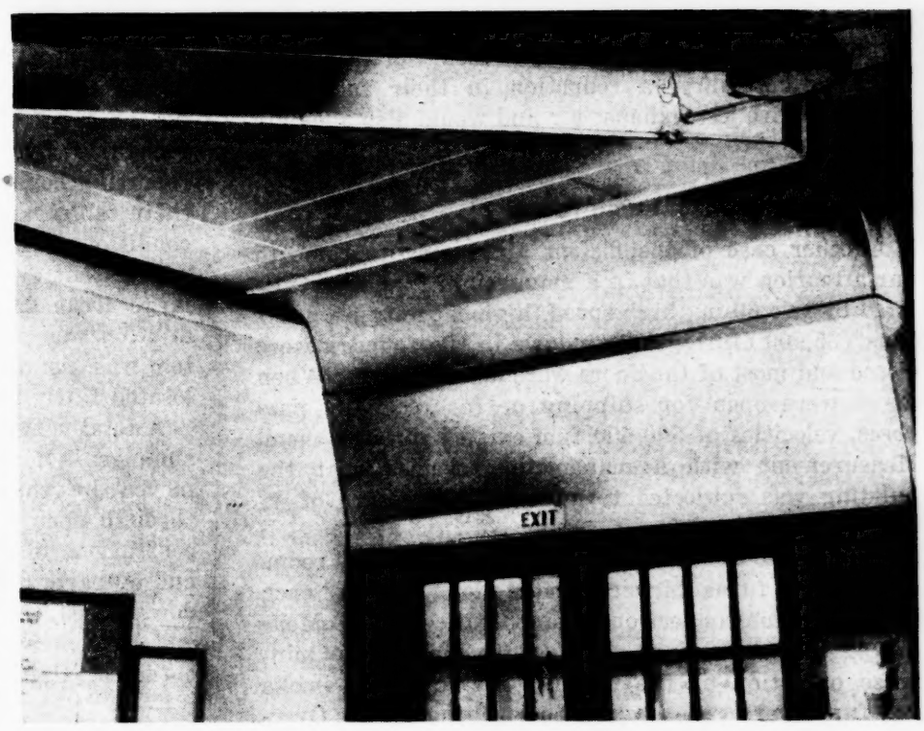

Fig. 3. Air curtain installed in a die cast department to prevent cold draft through doorways.

chines, with the result that the inlet air was contaminated with dust. In addition, the outlet from the supply pipe was located near the ceiling in proximity to the exhaust fans, thus creating a short-circuiting.

Measurements revealed that the fans were exhausting no more than one-quarter of their total capacity.

Vertical baffles were installed preventing the short-circuiting of the fans, but as yet no provision has been made to supply the necessary make-up air. As a result, smoke and fumes are uncontrolled during the winter months.

Paint Spray Booths too Large

An interesting case of failure to provide supply air was found in a spray painting room approximately 35 ft long, 15 ft wide and 15 ft high. Six spray booths approximately 4 ft wide and 6 ft high were lined along one wall. In the opposite long wall were two doors approximately 6 ft x 5 ft. With the fans in operation and the doors closed, velocities through the spray booths averaged 80 fpm, which was insufficient for adequate control; 125 fpm was the minimum advocated. The solvent vapor in the room was quite noticeable under existing conditions.

When the doors were open, a velocity of 275 fpm was found to exist and the velocity through the booths increased to 150-180 fpm. However, due to the short width of the room, velocities through the doors were great enough to cause a rebound from the backs of the opposite booths and this was sufficient to interfere with adequate control.

The difficulty in the whole matter lay in the construction of so small a room. Because of fire prevention regulations, fireproof construction was required, and thus a small room was considerably less expensive. It would have been better to provide a larger room in order to allow lower velocities from the inlets. The feasible method of improvement is to provide inlets high in the wall with baffles to direct the air at the ceiling. Since the spray booths used were twice as large as necessary, a reduction in their face area would require less exhaust air and would also alleviate conditions.

Ventilation of Magnesium Foundry

Another case of insufficient air supply to come to our attention was that in a magnesium foundry ventilated by two 60-in., high-speed, high-capacity propeller fans (85,000 cfm). All windows in the foundry were closed and most of the doors were usually closed. When doors were open for shipping or for receiving purposes, velocities of 500-600 fpm existed through them. Measurement with a manometer revealed that the building was subjected to a negative pressure of ¼ in. w.g.

Adjacent to the main foundry was the furnace room. Six pit type furnaces were located along one wall each having its flue connection to a central chimney. Melting of the magnesium alloy required a flux to minimize oxidation of the metal. Consequently, smoke and fume were generated in the melting room. Overhead openings in the roof had been provided to remove the fume, but the negative pressure inside the building was more than enough to offset the natural draft effect of the hot fume. As a consequence, outside air entered through the roof openings, diverting the rising fumes and carrying them into the foundry proper. The result was a murky, irritating atmosphere.

The principal sources of fume in the furnace room were not the melting crucibles themselves, but rather the trays in which the dross was placed. In addition to these sources, the crucibles gave off fumes after pouring had taken place, especially during the removal of slag. Local exhaust hoods at these points would have removed 90% of the fume at the source.

The problem was further complicated by the fact that fluoride compounds were incorporated in the molding sand to inhibit oxidation. While no hazard to health was found during molding operations, significant amounts of fluoride were released to the working atmosphere during the shake-out, which occurred at the center of the foundry. A ventilated shake-out station was the logical method of control at this point.

With the installation of local exhaust, the total ventilation rate would be lower and the problem of providing sufficient heated air would be considerably lessened. One acceptable means of doing this has been described by Odabashian.* Air supply from the outside is heated by steam coils and sent to the room through a distributing system. In addition, long narrow supply slots are located over shipping doors. Opening the door actuates a switch causing the fan to force air from the nozzle downward, forming a warm air curtain which tempers the inrushing air. In some instances the system is used continuously, while in others, it is used only when the doors are open. It is a practical method for the type of small jobbing foundries located in New England.

Solvent Vapors in Rubber Plant

In a rubber plant manufacturing Army raincoats there were noticeable differences during summer and winter months in the concentration of solvent vapors in the workroom. Such conditions have long been recognized by industrial hygienists, many of whom in reporting conditions found in industry distinguish in their tables and charts between summer and winter conditions. The work in this plant was of such a nature that evaporation of the solvent took place over large areas and in such amounts that ventilation by dilution was preferable to local exhaust. Such a system was installed in the workroom with exhaust inlets located fairly uniformly throughout the working area.

A total ventilation rate of 42,000 cfm existed in the summer. Of this approximately 20,000 cfm was removed by the exhaust system and the remainder through open windows. Under these conditions concentrations of vapor were found to vary between 15 and 50 parts per million. In the winter, with all windows closed, the system was removing only 10,000 cfm and concentrations ranging from 150-460 ppm were obtained. Under these latter conditions twice as many

*Odabashian, R. J. "Profits in Air—Westinghouse Electric & Mfg. Company Installs Three Air Curtains to Prevent Cold Drafts Through its Doorways at its East Springfield Plant." HEATING AND VENTILATING, November, 1943.

Fig. 4. A line of soldering pots with local exhaust require careful planning of make-up air.

workers were employed and the solvent consumption was correspondingly greater. When windows were opened, velocities inward of from 400-600 fpm occurred, thus indicating an insufficient supply of air.

This situation could be remedied by the provision of a suitable warm air supply system equal in capacity to that of the exhaust system.

Troubles in a Printing Plant

A small printing plant received complaints from the employes concerning the lack of proper light and ventilation. The concern had properly segregated the proofreaders in a sound-treated room (22 ft x 8 ft x 9 ft) provided with an overhead exhaust duct and an air inlet at one end connecting with an adjacent room. Pairs of employes worked in small cubicles formed by partitions approximately 5 ft high having an opening at the bottom, however, about 2 ft high. Complaints indicated that the workers were uncomfortable, drowsy, and some even developed headaches. When questioned, they stated that the room was "stuffy" and had "insufficient air." While some of these effects were contributed by the improper quantity and quality of the illumination, we were convinced that the lack of proper ventilation was also responsible.

Measurements showed the total ventilation rate to be 380 cfm. The Kata thermometer indicated that velocities of 9 to 25 fpm existed in the cubicles. The room air was found to be 75F D.B., 62F W.B., and relative humidity 48%, resulting in an effective temperature of 69.5F. This condition is within the winter and summer comfort zones. Despite the adequate volume of ventilation supplied, the relatively low velocities in the booths were responsible for the absence of skin stimulation necessary for comfort.

The system was reversed to provide air from the ceiling through proper type diffusers in order to create velocities in the cubicles of 25-30 fpm. In addition, the supply air was obtained from outdoors and tempered, rather than from an adjacent room. Since no more than six workers were involved, the rate of ventilation of 380 cfm exceeded the minimum required (30 cfm per person).

While air supply was not neglected in this case, the problem of proper distribution was overlooked, resulting in objectionable conditions.

Not only did this work impress us with the need of supplying fresh warm air in the winter to replace the air removed by exhaust systems, but it also emphasized the value of local exhaust hoods. The need for fresh supply air would be greatly reduced by the use of local exhaust ventilation instead of general ventilation. If the contaminating operations are enclosed and exhausted, the amount of air to be exhausted is greatly reduced from that required when the contaminants are allowed to escape into the general plant air and are then reduced to safe limits by dilution.

Several of the cases cited above emphasized the need for proper distribution as well as the need for provision of outdoor air. Although workers are not consciously aware of odors within a confined space, they are unconsciously reacting to these odors. In addition, the tonic effect of slight skin stimulation through mild air currents should not be neglected. Drowsiness, dullness and general apathy are directly attributable to stagnant atmospheres. Fresh outdoor air should be supplied at all seasons, but it should be tempered during the winter months. Volume requirements will vary with the size of the room and the number of occupants, their degree of activity, as well as their social standing and personal habits. A positive supply of approximately 30 cfm per person is indicated in most instances in the absence of conditions where toxic materials are encountered. In the latter case, the requirements for proper control of the contaminant will, in general, exceed the demand by the room occupants.

At least two of the cases described show the need for segregation of sedentary and active workers. This problem is accentuated when both males and females work in the same room, especially because the women are more apt to be performing the less active jobs and to be wearing lighter clothes. In many cases a two-fold purpose is accomplished by the grouping of sedentary workers, as by such separation they are removed from noisy or otherwise distracting areas, with a consequent increase in ability to concentrate.

We recommend the following measures to those who are designing exhaust systems and who are interested in minimizing the amount of make-up air to reduce the heat load in winter:

(1) Reduce the amount of exhausted air by installing local exhaust hoods wherever possible.

(2) Provide for a volume of heated air equal to that exhausted.

(3) Supply at least 30 cfm of tempered outside air per worker in the absence of toxic air contaminants.

Recirculating Spray Booth Exhaust

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The author develops a mathematical method of showing maximum spray booth concentrations that will develop when various proportions of exhaust air are recirculated. The possibilities of spray booth economy with exhaust recirculation are pointed out.

IN the majority of modern industrial plants, exhaust ventilation systems of various types and designs are used for the removal of obnoxious and harmful vapors, gases, fumes, and dusts produced at certain processes. The volume of air exhausted from some of these processes reaches large proportions, hence a large amount of heat is lost during the winter months by the exhaust air. This is especially true for plants located in the northern states.

Perhaps one of the greatest offenders with respect to heat loss by exhaust air is the paint spray booth. It has been the author's experience that in many instances booths exist in which the cross sectional area of the booth is large in comparison to the cross sectional area of the objects to be painted, the relation being necessitated by such other factors as size and shape of construction of the object. In such instances particularly, a large volume of air is exhausted in order to produce the desired air movement about the object to be painted, and the concentrations of thinner vapors in the exhaust air are comparatively low.

This problem of heat loss by exhaust air from large paint spray booths has been brought to the attention of the author many times and the question has been asked by industry on several occasions, "Is it possible safely to recirculate part of the exhaust air directly through the booth or workroom without adsorption of the thinner vapors, provided the paint pigment is removed, and the amount and properties of thinner sprayed are known?"

The purpose of this article is not to advocate the recirculation of contaminated exhaust air, but to develop a mathematical method by which, theoretically, the rise in vapor concentration can be shown for any amount of recirculation up to 100% and to point out possibilities of such procedures.

For the purpose of studying the rise in vapor concentrations produced in the booth by recirculating part of the exhaust air back through the booth, consider a system as shown in Fig. 1, in which the amount of air recirculation can be controlled or set at any amount up to total or 100% recirculation.

Assume for the purpose of this investigation, that the painter in the booth sprays a constant stream of vapors producing a constant vapor concentration in the exhaust air with the gate at *D* closed. Designate this constant concentration as *K*. Then if the gate at *D* is partly opened a unit volume of air flowing through the duct *B* will have the concentration *K* until it reaches the junction of the fresh air intake at *C* where it will be diluted by the ratio of contaminated to total air. Call this ratio $\frac{r}{A}$

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*P. A. Engineer (R) U. S. P. H. S. on assignment to Maryland. Present address: Tennessee Department of Public Health, Nashville.

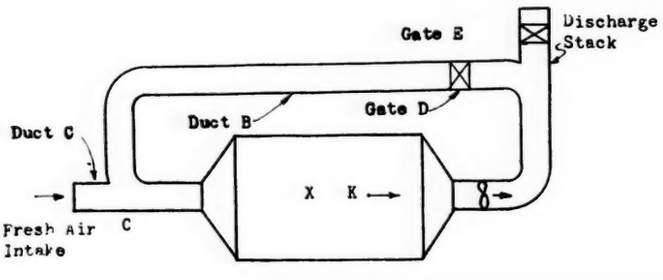

Fig. 1. System in which amount of recirculated air can be controlled.

K = constant vapor concentration produced in the exhaust air by the sprayer, ppm.

$\frac{r}{A}$ = ratio of contaminated to total air, cfm.

n = number of times recirculated air is passed through the booth.

C = vapor concentration in the booth at point X after dilution with fresh air entering duct C and before re-contamination by K.

S = stock vapor concentration, ppm, equal to $C + K$ for any value of n.

Table 1 – Rise in Vapor Concentration for *n* Recirculations

n	$C_n = S_{n-1}\frac{r}{A}$	$S_n = C_n + K$
0	0	K
1	$K\frac{r}{A}$	$\frac{K(r+A)}{A}$
2	$\frac{K(r^2+rA)}{A^2}$	$\frac{K(r^2+rA+A^2)}{A^2}$
3	$\frac{K(r^3+r^2A+rA^2)}{A^3}$	$\frac{K(r^3+r^2A+rA^2+A^3)}{A^3}$
4	$\frac{K(r^4+r^3A+r^2A^2+rA^3)}{A^4}$	$\frac{K(r^4+r^3A+r^2A+rA^3+A^4)}{A^4}$

Fig. 2. Showing the manner in which booth concentrations approach limits for each set of recirculation conditions such as those shown in Table 2.

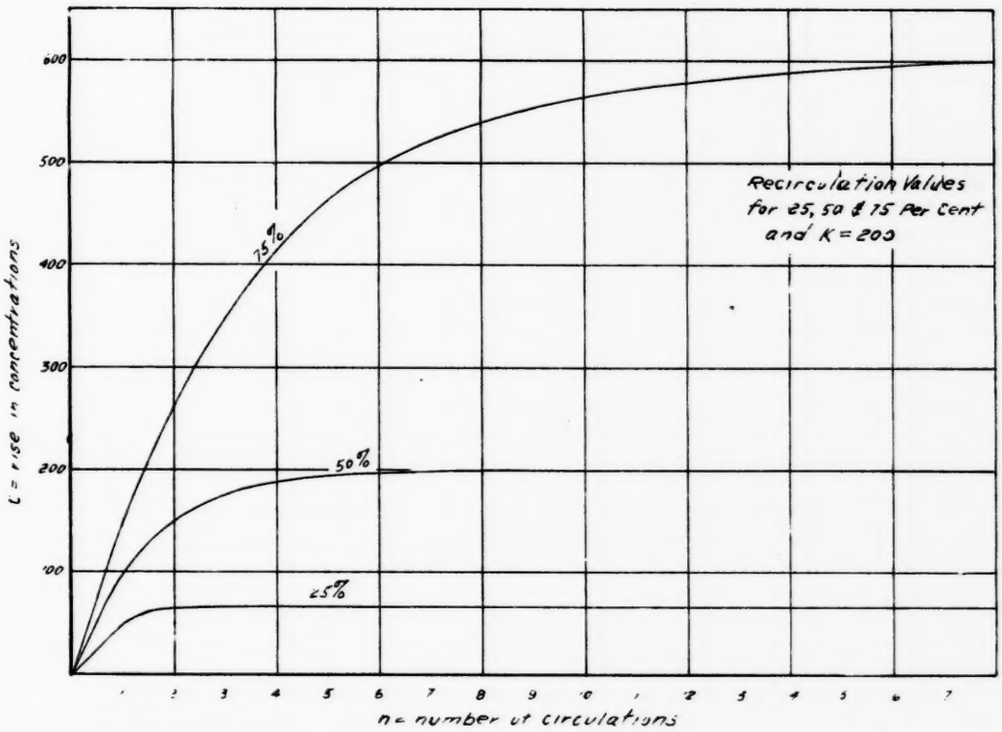

Table 2 – Rise in Concentrations Where Sprayer Produces 200 ppm

50% Recirculation		
n	C	S
0	0	200.00
1	100.00	300.00
2	150.00	350.00
3	175.00	375.00
4	187.50	387.50
10	199.90	399.90
15	199.99	399.99
∞	200.00	400.00

The concentration at X, any point in the booth after dilution and prior to passing position of the painter, will rise with the number of times a given fraction of contaminated air is recirculated as well as with $\frac{r}{A}$. The rise in vapor concentration for a number of recirculations is worked out in Table 1.

From Table 1 it can be seen that the concentration C at point X for n recirculations will be the series as follows: Equation (1);

$$C_n = \frac{K(r^n + r^{n-1}A + r^{n-2}A^2 + r^{n-3}A^3 \ldots rA^{n-1})}{A^n}$$

For all recirculation ratios between zero and one hundred per cent the ratio $\frac{r}{A}$ can be expressed as a fraction in which $r = 1$ and A, the denominator, some positive number greater than 1. For example; for 25% recirculation $\frac{r}{A} = \frac{1}{4}$; for 50% recirculation $\frac{r}{A} = \frac{1}{2}$ and for 75% recirculation $\frac{r}{A} = \frac{3}{4} = \frac{1}{1.333}$.

Hence, with $r = 1$ equation (1) can be written

$$C_n = \frac{K(1 + A + A^2 + A^3 \ldots A^{n-1})}{A^n} \qquad (2)$$

The expression in parentheses in the above equation is a geometrical series whose summation when $A > 1$ is $S_n = \frac{A^n - 1}{A - 1}$, hence

$$C_n = \frac{K(A^n - 1)}{A^n(A - 1)} \qquad (3)$$

From equation (3) the limit of C for all recirculation ratios between zero and one hundred per cent can be shown, as for example, for 25% recirculation, $r = 1$ and $A = 4$.

$$C_n = \frac{K(4^n - 1)}{4^n(4 - 1)}$$

Where n is very large;

$$C_n = \frac{K(4^n)}{4^n(4 - 1)} = \frac{K}{3}$$

Similarly for 75% recirculation

$$\frac{r}{A} = \frac{3}{4} = \frac{1}{1.333}$$

$$C_n = \frac{K(1.333^n - 1)}{1.333^n(1.333 - 1)}$$

Where n is very large;

$$C_n = \frac{K(1.333^n)}{1.333^n(1.333 - 1)} = 3K$$

To further illustrate these limits an arbitrary value of $K = 200$ ppm is taken, C and S calculated and tabulated in Table 2 for 50% recirculation for several values of n. These values and those for 25% and 75% are plotted in Fig. 2.

Obviously, since n is usually very large on a continuous operation, it is the limit of C_n where n approaches ∞ that is of importance to the operator of the gates at D and E in Fig. 1. Also, it is the degree of allowable recirculation which is usually unknown.

Example

For example in a booth similar to that shown in Fig. 1, in which turpentine is used and which is exhaust ventilated at a rate of 10,000 cfm, the constant concentration produced in the exhaust air is found to be 200 ppm ($K = 200$). If we now assume a working atmosphere concentration of 75 ppm (according to Hemeon, H&V:12:45:p95) not to be objectionable, we can open gates D and E in series sufficiently to allow C_n to approach 75 ppm as a limit.

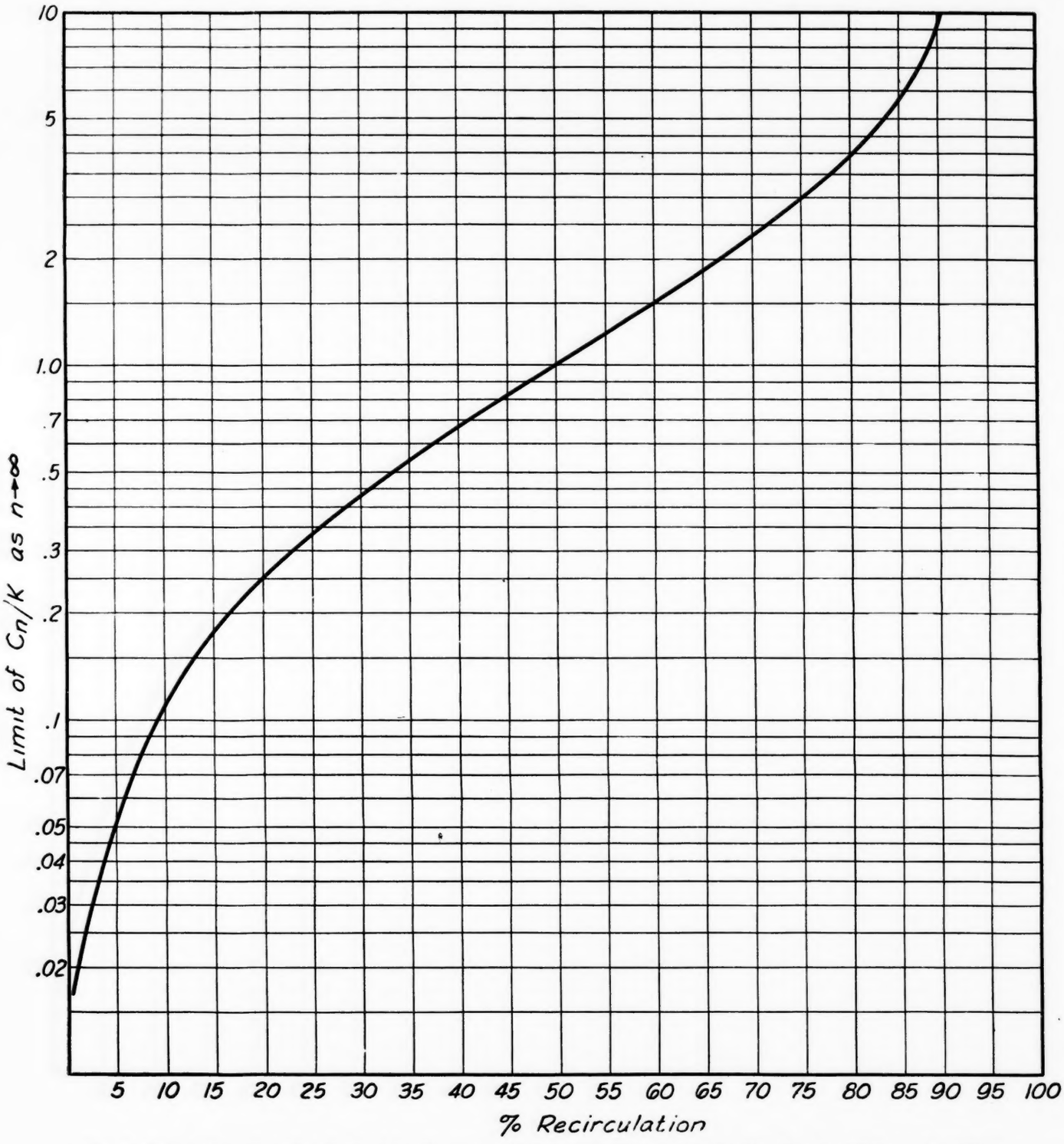

Fig. 3. Curve describes the limit of booth concentration per stack concentration for 0—100% recirculation.

If $C_n = 75$ and $K = 200$, $\frac{C_n}{K} = .375$.

Fig. 3 shows per cent recirculation as a function of C_n/K, and it can be seen that, for this example, recirculation of 27% will keep C_n within the desired limit. Thus the gates in series safely can be set to allow 25% of 10,000 or 2500 cfm to pass through duct B.

Conclusions

From the derived theoretical data, it appears that in certain cases part of the exhaust air from which paint pigment is removed could be recirculated directly without producing heavy vapor concentrations in the booth, as for instance, in existing booths in which the maximum concentrations reached in the exhaust air are well below the toxic limit. Such a procedure would of course necessitate accurate knowledge of the vapor concentrations reached in the exhaust air, as well as accurate toxicological knowledge of the thinner used.

On automatic spray painting processes in which human exposure is not a limiting factor in vapor concentration levels in the booth, it is probable that considerable heat loss can be eliminated in recirculating part of the exhaust air. The limit of the vapor concentrations allowed to build up in the booth and discharge stack would necessitate accurate knowledge of the fire and explosion hazards of the thinner vapors in question.

Piping Unit Heaters and Steam Main Drips

T. W. REYNOLDS

This article presents a practical, detailed approach to methods of lowering costs, increasing headroom and maintaining efficiency in piping connections for unit heaters and steam main condensation drips.

PERHAPS the infrequency of the problem among engineers discourages their making a detailed study of piping connections for unit heaters and for drips at the ends of steam mains. Most examples of connections of this kind appear to be hastily drawn to illustrate single points. Ordinarily there is little consistency and little thought given to the best arrangement for collecting sediment, obtaining maximum headroom, proper operation and the saving of material and labor. With these points in mind the accompanying sketches and tables have been prepared to illustrate various combinations of the commonly used fittings as well as those not so widely used. Also illustrated are certain specialties which replace some of these fittings. It is realized that, in small heating jobs, fittings used should be only those commonly stocked. Otherwise work may be delayed and the cost in lost time may be more than the cost of material and time saved by the use of special fittings.

Cost of Piping Connections

Objection is sometimes made to the cost of a special fitting such as the one piece dirt pocket shown in Fig. 8 and 9, yet such a fitting saves the cost in material and labor of many other fittings and threads. For example, reference to Fig. 9 shows a dirt pocket in one piece which replaces (compared to Fig. 12) no less than four fittings and three nipples and increases the headroom between centers of supply main and trap outlet by 3½ in. (See Table 2.) When headroom is limited, inches count; especially so where the returns are not lifted to a higher level. The fittings and nipples replaced cost a total of $1.33, while the one piece dirt pocket costs $1.60. The slight increase in material cost is made up many times over in the saving of labor cost. Moreover, the result is a better dirt pocket, one with an interior baffle, as well as an increase in headroom of about 4 in. from center of main to the lowest point.

In the final analysis, there is little difference in material cost, whether one or the other of the many arrangements shown is used. With the exception of the arrangement shown in Fig. 10, which is desirable mainly because of its compactness for support, there is a difference in cost between the other illustrated steam main drips of only about 8%. (See Table 2.) As for the unit heater connections, combining the lowest costs of top and bottom connections results in a saving of only $2.60 compared to the combination of highest costs. (See Table 1.)

The material cost of unit heater connections is a greater proportion of the total cost of unit heater and connections than would ordinarily be assumed. The unit heater in the case shown costs $42.35 [or $64.19 (See Table 3) when its thermostat, switch, conduit and wiring are included], while the piping connections add a cost of about $26, in all a total material cost per unit heater complete with all connections of about $90. Unit heater costs will vary with the size, but the size of piping connections will not vary from those shown,

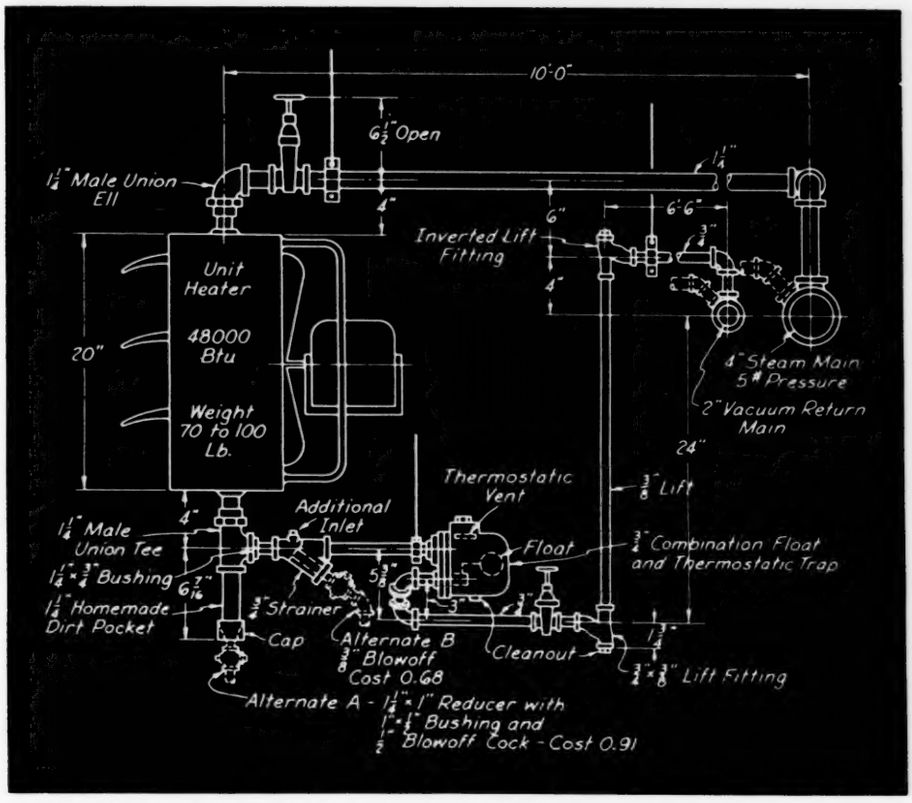

Fig. 1. Supply and return connections for unit heaters. Blow-off (either A or B) on return side of heater. Connections cost $26.55

Table 1 – Cost of Material for Unit Heater Connections Illustrated

Fig. No.	Cost of Material, $		Vertical Distance, Inches, Unit Heater to		
			Center Line of		Lowest Point
	Supply	Return	Supply	Trap Outlet	
1	10.52	16.03	4	6⅜	11⅛
2	13.50	13.57	4	6⅜	11⅛
3	9.73		2		
4	10.52		2¾		
5	9.97		6 5/16		
5	9.97[2]		2 13/16		
5	9.63[1]		6¼		
5	9.73[3]		2¾		
6		14.74		4⅜	9⅛
7		15.05		8⅝	13⅛
7		14.79[2]		5⅛	9⅞
8		16.22		10 11/16	15 7/16
8		15.98[2]		7 3/16	11 13/16
8A	7.14		12¼		

[1]With ell.
[2]With union in horizontal.
[3]With union in horizontal and with ell.
Costs include tees in supply and return mains and all piping, etc.; between these points. Cost of unit heater not included. Supply runout has 3-ply air cell insulation. No insulation on return. Heater shown midway of run when both mains would be at the same elevation. Unit heater, 48,000 Btu with weight 70 to 100 lb.

except for very large sizes of heaters. Hence the fewer the number of unit heaters or the greater they are in capacity, the lower the total cost for connections.

Large Trap Important

The cost of steam main drip connection is rather high because the trap and the drip connection were made 1¼ in. in size. Many designers use a much smaller size of trap. However, when time is taken for the necessary calculations, it will be seen that 1¼ in. is none too large. Assuming 200 ft of steam main, average size 4 in., there is a column of 16 cu ft of air to be removed from the main when starting up cold. This is no particular problem since the air will be passed by the various unit heater traps, as well as by the trap at the end of the steam main. Nor is there any problem of condensate removal from the main once it is raised to operating temperature. At such times there would be only 22 lb of condensate per hr for the steam main trap to remove (200 lin ft or 236 sq ft times 300 Btu at 30% insulation loss divided by 960 Btu equals 22 lb). A ¾ in. trap would therefore be satisfactory for normal operation as it will pass about 70 lb of condensate at ¼ lb pressure drop through the trap, or 200 lb at a 2 lb drop, which is the standard pressure drop used in sizing traps where conditions are normal.

Table 2 – Cost of Material for Steam Main Drip Connections Illustrated

Fig. No.	Cost of Material, $	Vertical Distance, Inches, C.L. of Supply to	
		C.L. of Trap Outlet	Lowest Point
9	30.01	4⅝	7⅞
10	28.67	15⅜	17⅞
11	30.60	7 13/16	11½
12	29.81	8⅛	11 11/16
13	31.60	9 3/16	12¾
14	31.44	6 13/16	10½
15	29.38	4 13/16	11½

Costs include 2 in. tee and adjacent hanger to and including bushing in return main and adjacent hanger. No insulation on return. Supply main usually ends up no smaller than 2 in. and at runout to last riser of not less than 1¼ in. size. Mains pitched 1 in. in 25 ft. Length of run 200 ft without intermediate drips.

However, the steam main in the case assumed weighs 2180 lb. Since 0.1175 is the specific heat (or Btu required to raise one pound of steel one degree) and the rise is from 60F to 228F at 5 lb pressure, there would be 45 lb of condensate, or 50 lb with weight of covering also raised to temperature; whenever the system is started up. If this condensate were required to be removed in one hour, a ¾ in. trap would still be of satisfactory capacity, but the main may be raised to temperature in the first five minutes after steam is turned into it when cold. The trap must then pass condensate at the rate of 600 lb per hr. A 1¼ in. trap is therefore required, since it will pass 600 lb at ½ lb pressure drop.

The ½ lb drop was selected for sizing the trap because the steam pressure normally available of 5 lb may be only ½ lb or even less when pressure is rapidly dropped by ex-

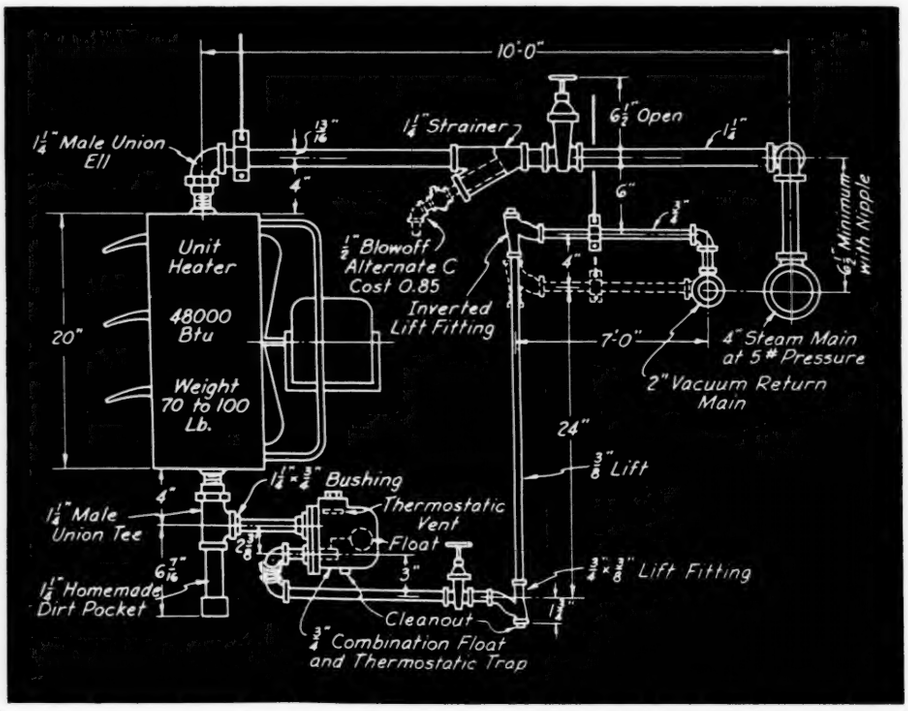

Fig. 2. Supply and return connections for unit heater. Blow-off (Alternate C) on supply side of heater. Connections cost $27.07.

cessive condensation at the start. It is desirable that there be sufficient pressure left after passing through the trap to negotiate the lift, if any, and in any event, this first rush of condensation is not at the steady rate assumed in the calculation. Condensation must not be allowed to accumulate for even brief moments, to come in gulps, or to cause water hammer, which may damage the trap.

That it is much more important to use a large size trap on a steam main drip than it is on a unit heater, can be said with due appreciation of the necessity for quick removal of air and condensate from the unit heater for the sake of efficiency and the elimination of water hammer. A unit heater is in reality a quick condenser with no volume for storage and with intermittent fan operation. Furthermore, a small quantity of air will block off a large amount of its heating surface. On the other hand, as a rule the heater weighs only from 70 to 100 lb, not very much metal to raise to temperature, and the capacity of the heater is based on 60F entering air temperature. Condensation for the capacity of heater shown is 50 lb per hr for normal operation and only 2 lb for warming its metal up to temperature. If this warming up takes place in 1¼ minutes, the condensation would be at the rate of 96 lb per hr. A ¾ in. trap rated at 100 lb per hr would handle this condensation quite satisfactorily with only a ½ lb pressure drop.

Another factor entering into the sizing of traps and the use of lifts is the steam pressure, whether it fluctuates or is maintained steady by make-up through a pressure reducing valve, or whether in later years the system may be operated at lower pressure. If 200 lb of condensate must be handled and a trap is selected to handle this quantity on the basis of a 2 lb drop in pressure through the trap, then the pressure must at all times be sufficient to provide for a 2 lb drop. For example, this same trap will handle only 70 lb of condensate at a ¼ lb pressure drop, as previously mentioned.

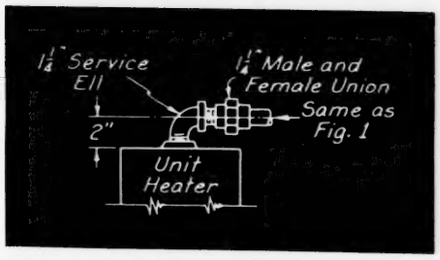

Fig. 3. Alternate unit heater supply connection.

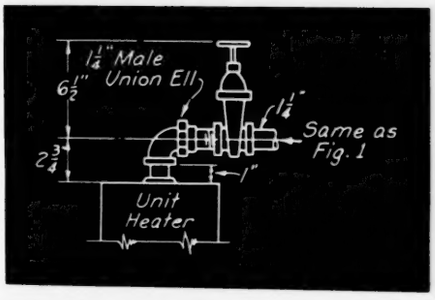

Fig. 4. Alternate unit heater supply connection.

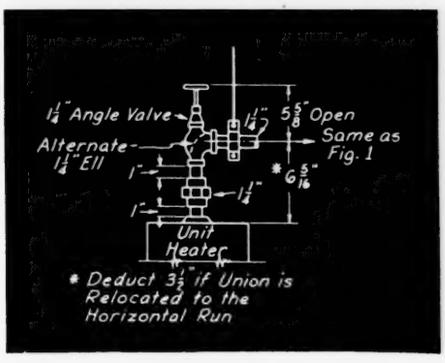

Fig. 5. Alternate unit heater supply connection.

Table 3 — Conditions Affecting Costs as Given in Tables 1 and 2

Costs are as of Dec. 1945 to the contractor and are for quantity.

¾ in. combination float and thermostatic trap	$6.80
1¼ in. combination float and thermostatic trap	11.20
Angle thermostatic trap	4.20
Straightway thermostatic trap	4.56
¾ in. strainer	2.00
1¼ in. strainer	2.80
Dirt pocket—one piece	1.60
¾ in. lift fitting	.80
1¼ in. lift fitting	1.12
1¼ in. gate valve	4.82
1¼ in. globe valve	5.38
Unit heater hangers—one pair	1.25
Unit heater	43.35
Thermostat	7.14
Snap switch	1.70
Wiring and conduit—30 ft run @ 40c per lin ft	12.00
Total for last 4 items	64.19

Labor, overhead and profit not included

$2.00 per hr fitter + $1.50 per hr helper × 8 hr day. Add 10% to labor for liab. ins. and compensation, Soc. Sec., State Unemployment, Federal Old Age Ins.

If in New York City add to material 1% for City Sales Tax and ½ of 1% for dues acct. local Contractors Code.

Then add to the total of material, labor and insurance, 10% for overhead and then 10% for profit.

Supporting the Unit Heater

A prohibition familiar to much of our unit heater literature, is that the unit heater must not be hung from the piping (See Fig. 1), because piping is intended for the conveyance of gases and liquids. This prohibition is hard to understand for pipe has structural characteristics which are sometimes utilized in other work. Piping properly hung or supported and with an adequate hanger also placed just before the supply drop to the unit should be sufficient for all purposes. Unless unit heaters have adjustable hangers and are free to swing or move on their supports, it would seem that a greater stress on the unit would be more likely where it is independently supported or fixed where it cannot move without distortions of the pipe or unit. Piping may expand and swing joints eventually move to accommodate the expansion, but the question arises as to which tends to move first, the swing joint or the unit heater.

Perhaps the concluding words of the paragraph just ended should be changed to read "the spring piece or the unit heater," for the inherent flexibility of sufficiently long branches of small pipe provides for the usual expansion. Before the fittings of so-called swivel joints turn on their threads, the pipe bends. If the

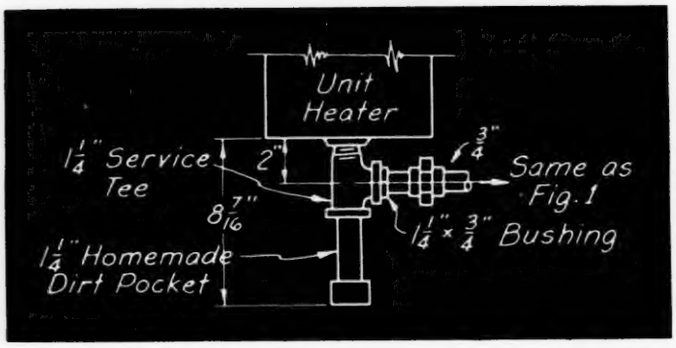

Fig. 6. Alternate unit heater supply connection.

fittings did turn the joints would leak. Expansion, of course, must be provided for in a proper manner, especially so in high or intermediate pressure installations where steam flows quickly and at high temperature.

The use of 45 degree ells at branches for the main as shown dotted in Fig. 1 do not constitute a swivel joint. Incidentally, in the case of the return branch shown in this same figure, the connection to main could be to the side of the main, because the ells near the trap outlet constitute a swivel expansion joint and there is no probability of back flow from the main when the tee is reducing to a small size of branch. The ells at the trap, however, were introduced into the arrangement, not for the purpose of expansion swing, but merely to pass the hanger of the return main by the steam pipe immediately above. Of course, the return could be hung from the supply main, but it is not general practice to do so. The taking down of one pipe should not necessitate the removal of a second pipe.

Suspending unit heaters direct from the supply main above them (Fig. 8A) is an interesting application which certainly saves on cost (See Table 1) due to elimination of all hangers and the runout with its fittings and insulation, but such an arrangement seriously decreases the headroom in most cases. The top of the unit heater would have to be down from the ceiling or beams at least 18 in. and probably much more than that, whereas in Fig. 2 only 8 in. is required for the same purpose, or in Fig. 3 only 6 in. The distance from the ceiling or beams to center of trap outlet would be about 43 in. for Fig. 8A compared to 30 in. when combining the connections shown in Fig. 3 and 6. Fig. 8A does increase the headroom below the supply main itself, but this is an advantage only where the condensate is lifted at each unit heater, in which case the return main is elevated to the same level as the supply main. Usually, even this advantage is lost, simply because supply mains have to be down quite a distance below the ceiling to avoid deep girders which they must pass under. Runouts can then rise and be run between beams without causing the supply main to be dropped any lower than the girders already make necessary.

The main reason for supporting unit heaters direct from piping, either the supply main or its runout, is the greater ease with which the heater may be rotated for direction of air discharge as desired to meet actual conditions in the field. The vertical drop piece supporting the unit should be about 2 in. in size for heaters weighing about 150 lb. Some heaters have special provision in their design for hanging from the pipes. Incidentally, in the supporting of pipes, a hanger should be located as shown in Fig. 10, just before the tee at the riser (not on the nipple from the tee), so that pipe can be run and hung and the connecting up of fittings be done later, and so that the weight supported is on the pipe rather than on a mere nipple.

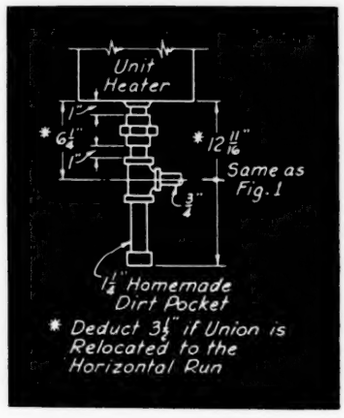

Fig. 7. Unit heater return connection with homemade dirt pocket.

Obtaining Maximum Headroom

Inserting union fittings in the supply and return at the unit heater (Fig. 1 and 2) permits easy rotation of the heater through a full circle to secure the desired direction of air flow. Wiring to motor must also be

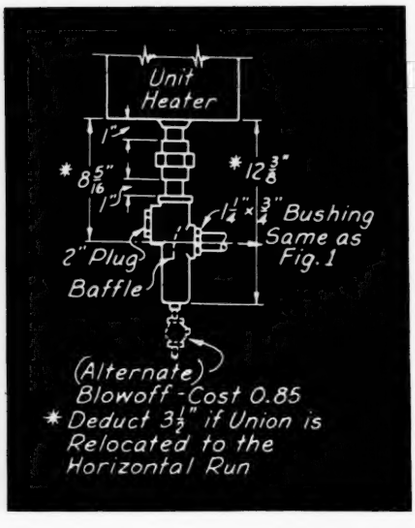

Fig. 8. (Left) One-piece dirt pocket on unit heater return.

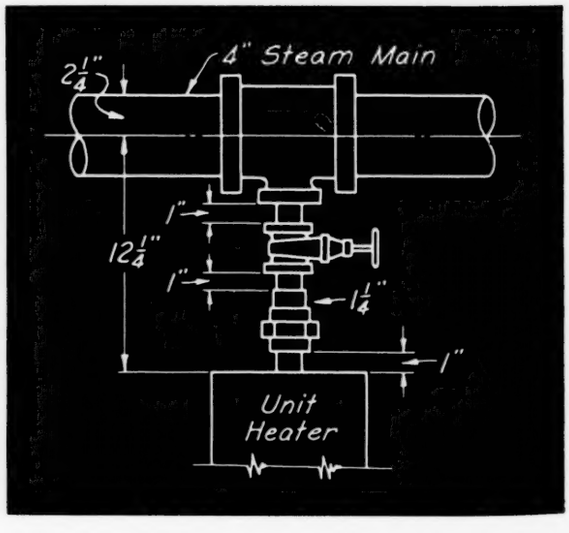

Fig. 8A. (Right) Unit heater suspended from supply main directly above.

arranged for such rotation. The union fittings should be what is known as the railroad type, a heavy, brass-to-iron, seat-ground union good for 200 lb pressure. A second advantage of these fittings over the ordinary union, as customarily installed in the vertical connections of the unit heater, is the increase in headroom they provide below the trap outlet. (See combination of Fig. 4 and 6 in Table 1 where the headroom is increased about 8 in. compared to combination of Fig. 5 and 7.)

Where the headroom is limited, there is a tendency to lessen the pitch or grade of the mains, hence the importance of using fittings which increase the headroom. A supply main and a return main (without lifts), each 200 ft long would require a total drop in elevation of 16 in., half of which would be saved (see preceding paragraph) by eliminating the ordinary type of unions from the vertical connections to the unit heater.

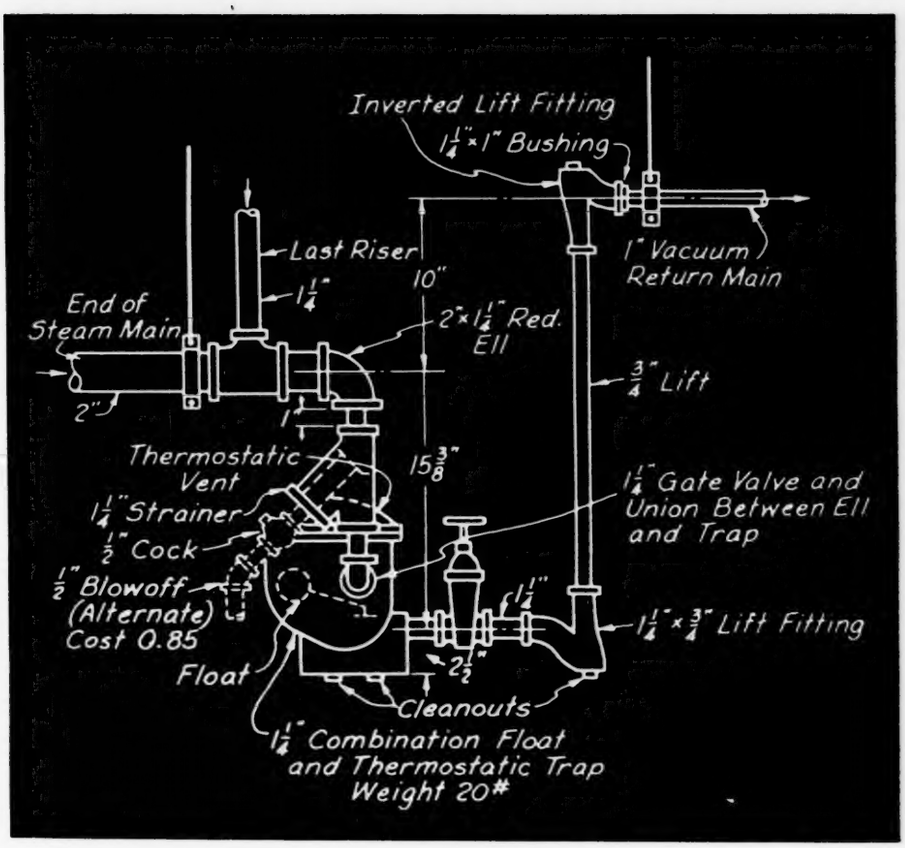

Fig. 10. Steam main drip with emphasis on compactness for support.

Unit heaters of the type having side connections also serve to increase the headroom, but they cannot be easily rotated.

Use of Unions

So-called street or service ells and tees (fittings with a male end) increase the headroom at unit heaters, but unions must then go in the runouts. If the supply runout allows for expansion of the main by spring of one of the pipes making up its assembly and the union is located in the spring piece, the faces of the union will be sprung apart and the union will leak. A union in the horizontal of the return rather than in the vertical saves on cost, due to the use of a much smaller size of union. A union in the drop from the unit heater would be of large size because the drop should be full size of heater outlet as required for better condensate removal and an adequate size of dirt pocket. On the other hand, the vertical supply drop to unit heater need not necessarily be made full size of heater inlet as the inlets are of the same size for several different heater capacities. The size of inlet pipe should be the same as the runout and the runout should be sized from piping tables.

Unions are not needed on both sides of the trap, because there are flanges at the trap which permit the removal of trap interiors for repairs. The necessity for removing the trap body should not occur.

Traps

Steam traps should be reasonably light in weight so that they can be readily mounted in a pipe line without other support. The thermostatic type of trap is fitted with a union and is much lighter and much cheaper than the combination float and thermostatic traps shown in the sketches. Thermostatic traps, however, are not sensitive to water, but rather to

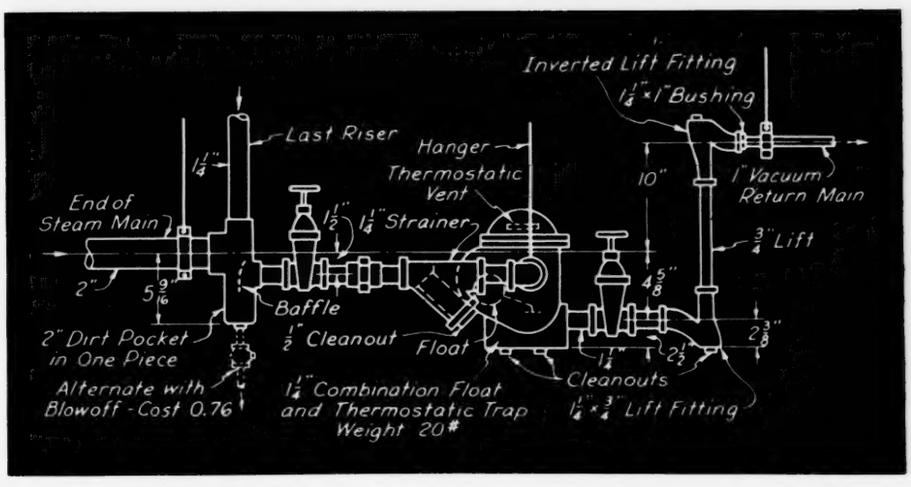

Fig. 9. One-piece dirt pocket on steam main drip.

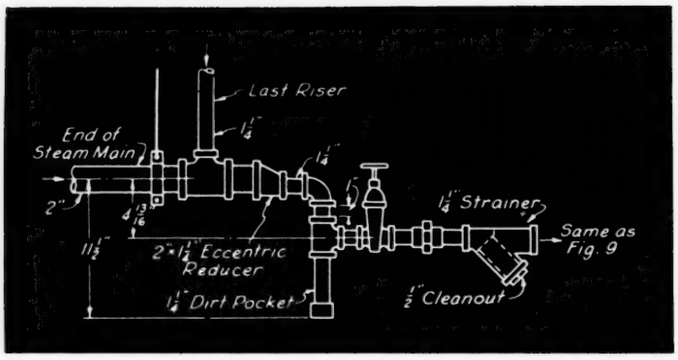

Fig. 11. Homemade dirt pocket on steam main drip.

temperature. Thus a cooling leg is required of sufficient length to dissipate the heat before it reaches the trap, particularly when there is superheat. The cooling leg may be either external or internal to the heater, dependent upon the make of heater.

A float trap takes water as it comes and takes it hot or cold, but a thermostatic trap can be sluggish in action, particularly with age, and may receive sudden gulps of condensate which has passed through the cooling leg too fast. If thermostatic traps are suitable for use with unit heaters, they should also be suitable for use on blast coils, but it has been learned from sad experience that blast coils have frozen up when drained by thermostatic traps.

Dirt Pockets and Strainers

When dirt pockets and strainers are used, they reduce the waste of hot condensate to the sewer upon first operation of a new system. Though the dirt pockets and strainers may never require a second cleaning, they are more apt to be kept clean if fitted with blow-off cocks (Fig. 1-2-8-9-10) for cleaning at any time without waiting for a week-end shut down. It is not always possible to clean the strainer mesh itself completely by blowing off, so eventually their baskets may have to be removed. On the other hand, the cost of small blow-offs is nominal, they make for easy cleaning and often serve to show when the strainer is so choked that it interferes with condensate flow.

The suggestion is sometimes made that the strainer should be placed in the supply pipe before the unit heater (Fig. 2) rather than after it in the return (Fig. 1). As placed in the supply, it protects the relatively small and valuable heat transmitting tube area of the heater from scale, etc., as well as the trap and the valve seat in the return connection. The larger size of strainer required costs only $0.80 more (Table 3) for the strainer itself, but when taken in connection with the total cost of runouts, the increase in cost is still less, only $0.55, as shown in Table 1 for Fig. 1 and 2. The real objection to a strainer in the supply arises from the pressure drop it causes in low pressure systems, particularly when fouled up a bit, for steam must flow through the supply line basket screen (See Fig. 16) while only condensate flows through the strainer placed in the return.

Strainers may also be installed in the vertical (Fig. 10), certain sizes have alternate inlets (Fig. 16), and some makes are fitted with a union. Still others are built into a trap to save on pipe fitting and to make certain that some protection is provided for the trap mechanism against scale and dirt. All strainers are in reality combination dirt pockets and strainers. Some dirt will be settled out in a pocket and that which is not will be blocked from passing on by a screen. Screens vary in mesh and therefore effectiveness, but the more effective they are the sooner they will be stopped up and require cleaning. The large pot type strainer was formerly selected for the ends of steam mains and for heating coils where condensation was great, but demand for and effectiveness of the "Y" type was so universal that manufacture of the pot type has practically ceased.

Patented dirt pockets can be installed in the horizontal or vertical where they replace the commonly used fittings (Fig. 8-9), and these should be used even when strainers come after them. They provide additional cleaning and storage of the heaviest particles of foreign matter to prevent fouling of strainer screens and reduce the frequency of removal and cleaning of strainer baskets. They do not eliminate the need for a strainer since lighter materials are apt to be carried past, particularly when sediment in the pocket is disturbed by a sudden flow of condensate or by the turning on of steam. A trap also serves as a dirt pocket, hence they come with one or more cleanouts as shown in the sketch.

Home made dirt pockets can be 1¼ in. by 6 in. vertical extension below trap inlet, though some recommend that they be made of 2 in. pipe 10 in. long. Obviously, the more storage they provide, the better they are for the purpose intended, but a pipe 10 in. long plus half the length of a 2 in. tee and that of a cap, will decrease the headroom about 6 in. Should the heater outlet happen to be only 1¼ in. there will be a further decrease in headroom of about 4 in. by the increaser and extra nipple required.

The Use of Valves

Obviously, the valve in Fig. 1 is placed on the supply side of the strainer, so that the strainer basket can be removed for cleaning without waiting for a shut down. The need for a second valve as installed in the vacuum return is not so obvious to some who tell you one has only to put a piece of cardboard over the open end of a return when disconnecting and the

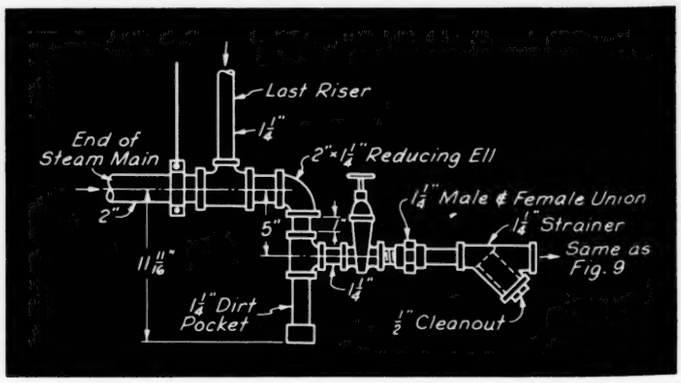

Fig. 12. Alternate to Fig. 11 for reducing steam main to dirt pocket and trap.

suction will keep it there. But suppose the system, while in operation, is opened only at the dirt pocket for cleaning. Then in less time than the telling, it is cleaned all right, but with the dirt transferred over to the strainer. If the cleanout of the strainer is opened, all of the dirt will be sucked into the system.

Valves should not be installed in the return drop from the heater, because this drop is of larger size and the valve takes up headroom. The lift pipe is the smallest of the pipes, but this is not the place for a valve, even though such a location would help to blow out the lower lift fitting whenever its cleanout plug was removed with the return valve closed.

All valves in the sketches are shown in upright position, though they may be otherwise installed where headroom is limited. Valves installed as shown will give less trouble and last longer. When the stem points downward, the bonnet acts as a pocket for dirt which sometimes interferes with valve operation and eventually destroys the inside stem threads. The bonnet may also rupture should the system be laid up and subjected to freezing temperatures. A further disadvantage is the possibility of jamming the spreader mechanism when double disc gate valves are used. A gate valve with a wedge disc should be used if the valve cannot be installed in upright position.

An angle valve installed as shown in Fig. 5 has more disadvantages than advantages. It may take up headroom because of its necessary upright position and the valve body has to take the weight of the unit heater. It does reduce the number of joints, save installation time, and replace an elbow and a nipple. But the usual statement that it gives less resistance to flow than the elbow and glove valve it displaces is misleading. The equivalent length in feet of 1¼ in. straight pipe to give the same resistance as the following valves and fittings of 1¼ in. size is 3, 34, 18 and 0.8 for an ell, globe valve, angle valve and a gate valve, respectively. The resistance is therefore cut in half by the use of an angle valve compared to a globe valve. But why make a comparison with a globe valve? An angle valve compared to an ell or gate valve has about five times the resistance.

The seat of an angle valve should never be above the inside bottom of the horizontal pipe. If it is, the horizontal pipe cannot be thoroughly drained and the resistance to flow is increased

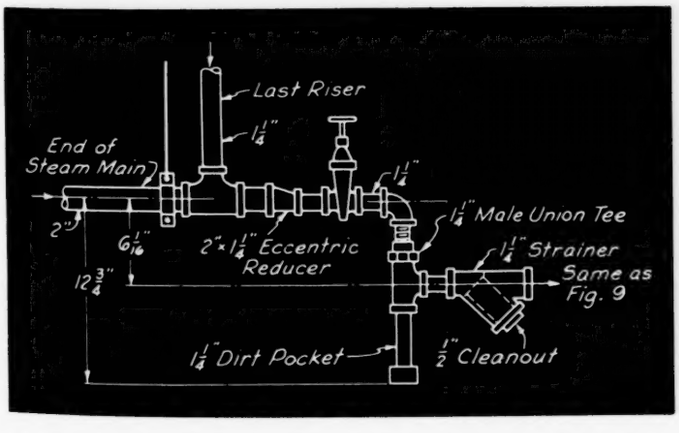

Fig. 13. Another arrangement of elements in Fig. 11 with male union on dirt pocket inlet.

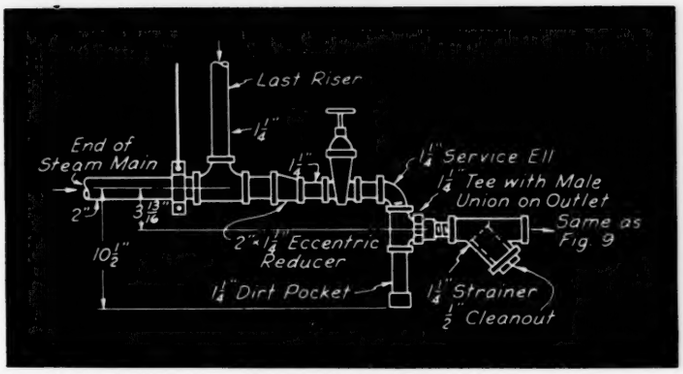

Fig. 14. Alternate arrangement with male union on dirt pocket outlet.

How does one know which type of angle valve he is getting? A cross sectional view of an angle valve in a catalogue is rare indeed, though such views are shown for angle radiator valves. An angle valve, other than the radiator type, is quite apt to have a high seat since a high seat reduces the lift or the number of turns required for the handwheel before the valve is fully opened.

The proper way to install an angle valve or a globe valve—whether with pressure above or below the disc—is the subject of an old controversy. The pressure should be above the disc, except in a few applications such as in a boiler feed line where pressure above the disc might cause the disc to seat and check the flow. On the other hand, pressure below the disc of a globe valve used to regulate the flow of steam to a pump would cause the pump to run wild should the disc become detached from the stem. The pressure below the disc would then push the disc up and make the valve fully open.

Experience has demonstrated that valves in hot services operate more efficiently and seat tighter when their operating parts are exposed to constant temperature. No doubt we are all familiar with the troublesome angle valves at radiators in one pipe steam heating systems where pressure is below the disc. When the valve is closed, its upper part cools and the steam contracts, unseating the valve enough to cause steam leakage into the radiator without letting the condensate out. The resulting water hammer and high velocity of flow eventually cause erosion of the disc and seat.

In recent years some engineers seem to prefer globe valves at unit heaters for reasons unknown to the writer. Even in a standard handbook, globe valves are shown in unit heater connections installed upright, no doubt unintentionally, since the interior web or diaphragm of the valve prevents drainage of the line when the valve is in such position. The valve is an important part of the detail shown by the handbook, though it would be better to use no valve at all than the kind of one shown. The globe valve, which by the way gets its name from the globular shape of its body, causes the flow to make two 90 degree turns. The resistance of an equivalent 34 ft of pipe is a fair percentage of the total pressure drop. A further disadvantage with a globe valve is its tendency to collect sediment when in the upright position.

A globe valve has many good points, but of what

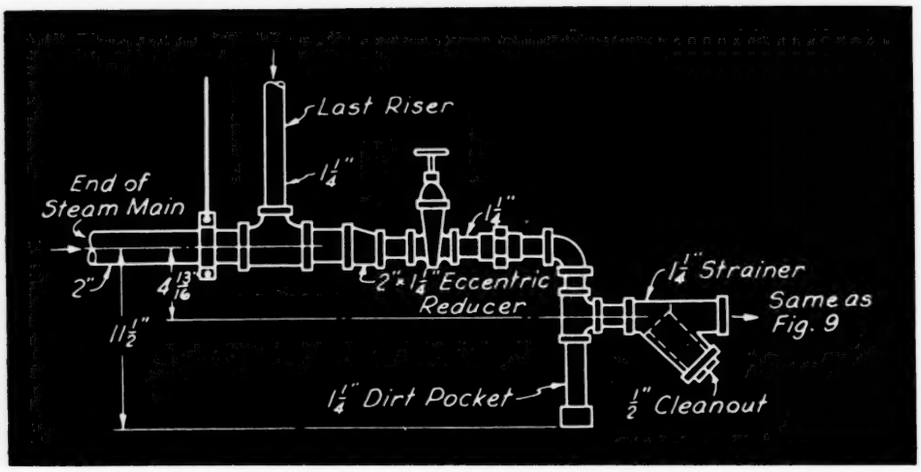

Fig. 15. Alternate steam main drip connection.

value are these points when the service is of a nature which cannot utilize them? For example, globe valve construction and disc action make it possible to make tight closure and to obtain very close regulation of flow by hand throttling. This is something we don't need with a unit heater, and if we did the throttling might soon use up what pressure is left after deducting the normal high pressure drop of the globe valve when fully open. This would become particularly noticeable in any industrial heating system having a fluctuating steam pressure. Incidentally, a gate valve has to be 60% closed before its resistance to flow equals that of a globe valve when fully open.

Globe valves have some other good points, which again cannot be taken advantage of for the applications under discussion, because a valve to a unit heater may be opened once and never again operated. For example, greater wear results from more frequent operation and from throttling, hence the convenient and quick regrinding features of globe valves make them desirable for such services. A further advantage is that less turns of the handwheel are required to open globe valves, thus reducing wear on the threads and saving the operator's time if operated frequently. Globe valves are said to be less expensive to manufacture, but recent quotations to the writer were higher for globe valves than they were for gate valves.

Gate valves, so called for their gate-like disc that moves across the path of flow, give straightway flow and complete drainage. They are intended for use with the disc in full opened or closed position. When used for throttling, as they should not be, the lower edge of the disc is subject to wire drawing and the disc is prone to destructive chattering. As gate valves are not so easily repaired, it is desirable that they have a union in the line adjacent to them wherever they are subjected to severe service. The spindle of a gate valve should not be closed down to its utmost while the valve is cold, as the spindle will increase in length under expansion when steam is turned on.

Lifts in Vacuum Return Systems

The lift fittings shown in the sketches were included not because they are absolutely necessary, but rather because they will help by preventing condensate from accumulating. Condensate is moved up as received in small quantities or slugs which are lighter than a solid column of water and require but little differential pressure for their lift. When the steam pressure is held at 5 lb, it is sufficient without the vacuum return to overcome the static head of the lift.

Lift fittings give better air and condensate removal. They also give quicker starting of the lift as the pocket or well is down below the horizontal pipe whose bore would otherwise have to fill before the lift would start, resulting in the further handicap of a heavier load and higher column. The small diameter or area of rising pipe is easily filled from the pocket and this small area, together with the inverted lift fittings at the top of the lift, keeps the slugs from falling back. Lifts can be made up with the usual standard fittings, though they cost more to install, and are not as efficient. Care must be taken to insure the sealing of the vertical part so that the difference in pressure each side of the well will force the water up the entire lift. The cleanout opening on the bottom fitting may be fitted with a blow-off cock for easy cleaning and test of trap action.

Flash Steam

All insulation was omitted from the lift and the return system because of the low temperature of the return, and further in order to dissipate any flash steam that might develop in going from 5 lb steam pressure to 6 in. of vacuum. The amount of flash steam is, of course, the difference in the heat of the condensate at the two pressures divided by the latent heat at the lower pressure, thus

$$\frac{196—169}{1001} = .036.$$

This means that about 4% of the condensate passed to the return will be flashed or re-evaporated into steam. The greater amount of sensible heat at the higher temperature and pressure will be converted into latent heat at the lower pressure.

In high pressure systems, the lifts are replaced by a single check valve. In such cases the check valve should have a metal seat, as a valve with such a seat has less probability of chattering than one with a composition disc.

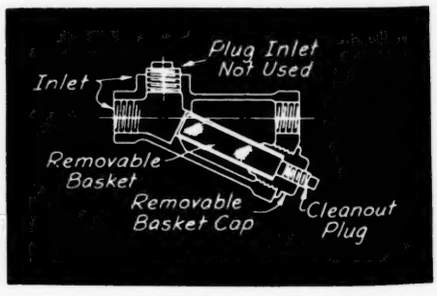

Fig. 16. Basket strainer with alternate inlet.

Heat Flow Pattern in Radiant Heat Panels

R. G. VANDERWEIL
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In this article, the sixth in the author's series[1] on radiant heating. Mr. Vanderweil explains in more detail how and where heat flows from the hot embedded tube in the ceiling panel.

THE study of the flow of heat within the panel proved to be one of the most intricate and most interesting problems met in connection with the development of practical design charts for radiant heating.

Preliminary—In a previous attempt made to solve the panel heat flow problem, a European investigator (Kalous) suggested an assumption that heat in a ceiling panel flows horizontally through the plaster layer, then makes a 90° turn and flows vertically up and down to the rooms above and below. Although the derived equations proved to be simple, their results could not be coordinated with the tests taken in the field and in the laboratory.

By 1942, a large number of test readings on panel heat flow had been taken by members of the staff of the Chase Brass & Copper Co. Development Department[2]. At first, attempts were made to coordinate these readings by a simple theory of sufficient accuracy to yield a practical solution. After conclusion of the room heat flow study, the author continued with these attempts, only to find that all assumed simplified formulas resulted in temperatures not in agreement with test readings. These discouraging results forcibly suggested development of a theory based on the actual panel heat flow conditions in the temperature field[3] of the tube.

When comparing the results obtained by this method with the readings, it was still found that a few of the tests were in poor agreement; a single and seemingly unimportant assumption as to the boundary condition of the panel was powerful enough to affect the final results of certain panels. In order not to further complicate the mathematics, the original assumption had to be adhered to, but with results adjusted by an empirical coefficient.

Even then, equations derived from this theory were entirely too cumbersome to be used for practical computations, and the final step in the development was to devise simple graphs from which accurate

[1]Previous articles appeared in the April, June, July, August, and October, 1945, issues of HEATING AND VENTILATING.

[2]The work of this department, headed by R. W. Shoemaker, consulting engineer, and consisting of Messrs. Rianhard, Selby, Osborne, Sidbury, Woodward, and Hamilton, is acknowledged. Also acknowledged is the work of Mrs. Virginia Hazen, who made the calculations necessary for the development of graphs referred to later, and of Dr. Wm. Whitmore, then of Massachusetts Institute of Technology, who solved the panel flow equations.

[3]The word *field* is here and subsequently used by the author to mean the region under the influence of heat flowing from the embedded tube, so that the usage is analogous to that employed in electrical or magnetic phenomena.

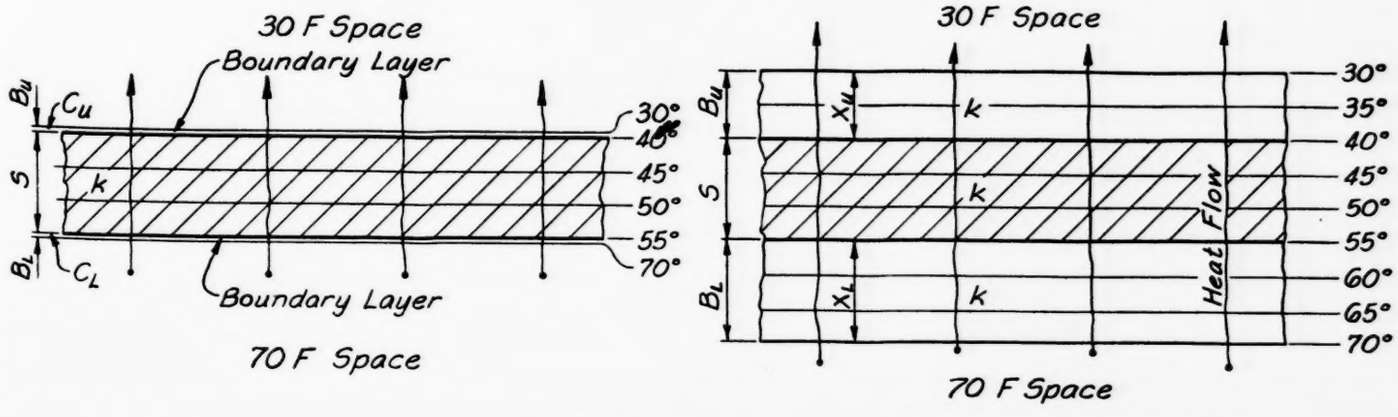

Fig. 1. (Left) An actual panel composed of structures of uniform conductivity k and the thin boundary layers of conductance C. Fig. 2. (Right) The equivalent panel. Here the boundary layers are replaced by an imaginary layer of material of conductivity k and such a thickness x that the resistance of the imaginary layer is identical with the resistance of the actual boundary of Fig. 1. (Resistance = 1/C)

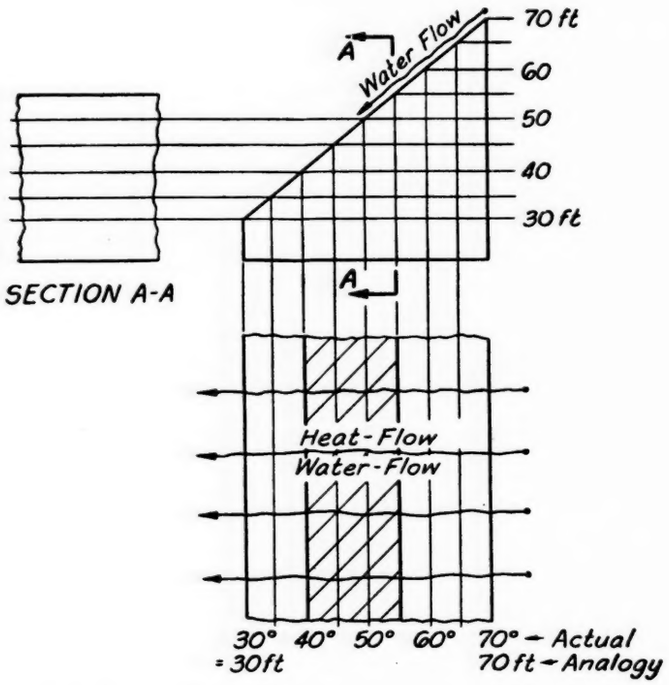

Fig. 3. The plan view compares the actual heat flow with the analagous flow of water. Since temperature conforms to elevation in the water flow analogy a "hill" results and is shown in elevation and section in the figure.

results could be read. Development of these graphs called for thousands of complicated calculations.

Parallel Flow of Heat

In order to visualize heat flow let us first consider the flow from a warm air layer (70F) at the ceiling of a room through the ceiling structure to air in the attic above (30F). For obvious reasons, points near the warm ceiling must be warmer than points located near the floor above. By connecting all points of equal temperature in this structure we obtain "lines of equal temperature" or isotherms, as shown in Fig. 1.

In this figure, the layer S represents a ceiling or floor structure of uniform conductivity; B_L is the lower and B_U the upper boundary layer. We define as boundary layer that very thin more or less stagnant layer of air through which the heat travels to or from the surface of the structure from or to the mass of air. Resistance to heat flow of these layers—although changing with their location and temperature gradients—is always great. This is clearly indicated by the well-known fact that in rooms of 70F air temperature, glass surfaces of 40F are common in cold weather. In this case, the temperature drop in the layer is 30F and since it is but several thousandths of an inch thick, it is obvious that its conductivity must be small and its resistance against heat flow great.

In Fig. 1, the lines connecting points of same temperature within the panel are shown. *Heat flows perpendicular to these isotherms,* from the warmer room to the cooler one as indicated by arrows.

Equivalent Panel

From Fig. 1 it is seen that the isotherms are equispaced through the homogeneous panel material of conductivity k, but at the boundary layers the isotherms are quite close. For purposes of simplification in heat transfer work, it is often desirable to consider the surfaces—that is the boundary layer—as being replaced by a layer of panel material having an equal resistance. In other words, as shown in Fig. 2, enough material X_U and X_L—of conductivity k—is added at the top and bottom to make the overall resistance of Fig. 2 equal to that of Fig. 1. Then the isotherms are all equidistant as is Fig. 2. Similarly, this is often done with compound walls of more than one material; all portions are reduced to an equivalent structure of one homogeneous material, and the resultant structure can be called the *equivalent panel.*

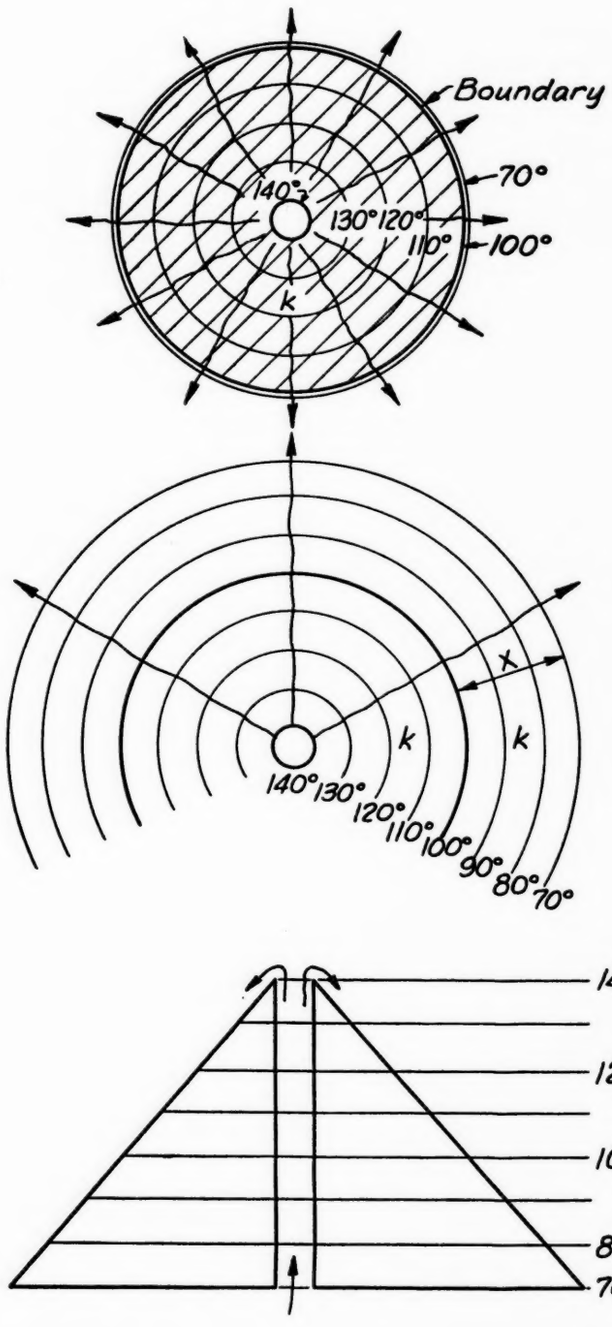

Fig. 4. (Top) The flow through a cylindrical slab and its boundary layer. Fig. 5. (Center) The equivalent slab, the boundary being replaced by material of conductivity k. Fig. 6. (Bottom) Analogy of water flow down the hill. Fig. 5 may be considered as plan view of the conical hill in Fig. 6 and the isotherms are then contour lines.

Since in Fig. 2, the terminal temperatures (30F and 70F) as well as the individual flow resistances are identical with those of Fig. 1, the heat flow conditions of both figures are identical.

Analogy to Water Flow

It is difficult to visualize an invisible process such as heat flow and, consequently, the analogy between the flow of water and that of heat is helpful.

Water flows in proportion to difference in head or elevation; heat in proportion to difference in temperature. Fig. 3 shows the flow of water, or heat, in a gravity "field". In the case of water—and heat—the rate of flow is greater, the closer the isotherms, the greater the slope. In both cases the direction of flow is at right angles to the equipotential lines; that is to the contour lines or, in the case of heat, isotherms. If water has a choice, more will flow down the steepest slope (close contours); so will heat.

Applied to a tube in a radiant heat panel, then, our first rule is that *heat from the tube always flows at right angles to the isothermal lines in the field of the tube.*

Radial Heat Flow

Next consider a case where a tube containing hot water is embedded in the axis of a cylindrical slab of conductivity k. The slab's surface temperature is 100F and the room in which the assembly is located is 70F. The tube proper is heated to 140F. If conventional tube materials such as steel or copper are used, it may be assumed that the water temperature is 140F. The flow resistance between water and tube surface touching the slab is small and the temperature drop in tube and bond may be neglected. The tube and cylindrical slab, as well as the air boundary of conductance C is shown in Fig. 4. Here, too, the surface of the circular slab is an isotherm and the boundary layer may be replaced by a layer of a conductivity k and thickness $x = \frac{k}{C}$. Fig. 5 represents such an "equivalent" slab (of constant conductivity) but may also represent the plan view of an equivalent gravity field, the elevation of which is shown in Fig. 6. It appears that our hill takes the shape of a cone, and if water is supplied to its top (for instance, through the tube) it will flow in all directions and, again, always perpendicular to the hill's contour lines—that is radially in the plan view Fig. 5. Similarly, heat in any cross section of the slab will flow radially out of the tube as shown in Fig. 4.

Heat Flow from Parallel Pipes

Fig. 7 indicates the isotherms of a system of parallel pipes embedded at the axis of successive cylindrical slabs or the contour lines of the equivalent gravity field, and Fig. 8 shows the cross section through the multiple gravity hill at section 8-8 of Fig. 7. It may be seen that the slope S_2 between the "hilltops" becomes less steep than the outer slopes S_1 of the first and last hill, but that there is still a distinct change of elevation between two neighboring tubes, no matter whether the section is taken at the tube center line or at the plan section 8-8. Note that elevations are equivalent to temperatures in the actual field.

Another interesting phenomenon may be noted. Since the water at any point of the triple hill flows along the steepest slope, that is, at all points perpendicular to the contour lines, only the outer flow lines of the first and last tube (p_1) are essentially straight in the plan view, Fig. 7, and all flow lines leaving the intermediate tubes must be curved (p_2 to p_4). As seen in Fig. 7, the curve of the flow lines is dependent upon the distance between the peaks (tubes) as well as the width of the base of the hill. Applied to the radiant heat flow problem we can say, as the second rule, that *the path of heat leaving the intermediate tubes is curved; the curvature, and thereby the intensity of heat flow, is dependent upon the tube center-to-center distance and the thickness of the slab.*

Heat Flow in Radiant Panels

The radiant heating panel (in the ceiling) is of less symmetrical shape and, therefore, its law of flow

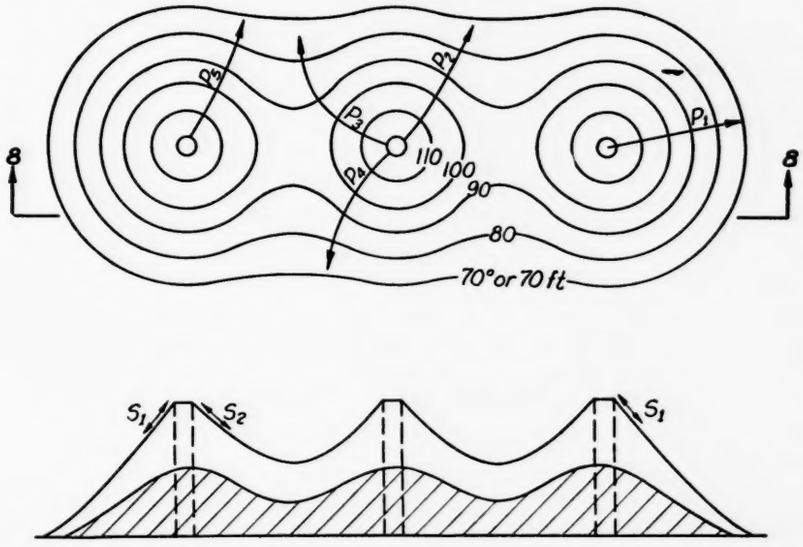

Fig. 7. (Top) a temperature field such as is found around three tubes simultaneously embedded in insulation or in a slab. In analogy, Fig. 7 presents also the contour map of a hill shown in elevation in Fig. 8. Water supplied to the hilltops flows along certain paths, which are generally curved as shown for example by flow paths p_1 to p_4. Fig. 8. (Bottom) is a cross section through the "hill" at line 8-8 of Fig. 7. It indicates the variation of slope in various directions—s_1 and s_2. More water will flow along the steep slope s_1 than along s_2.

of more complicated nature than that of the structure of Fig. 7. Also, there is a further complicating factor entering the computation problem in that there must

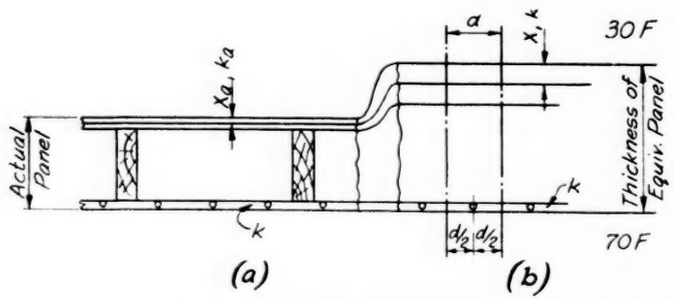

Fig. 9. The actual panel (a) composed of several layers of varying conductivity is replaced by an equivalent panel of constant conductivity, k, which has the same resistance against heat flow as has the actual panel.

be considered two distinct components of heat flow. First, there is the heat flow from the tubes; second, heat is flowing from the warm room to the cooler space above (as in Fig. 1) in the form of parallel flow.

This parallel flow may be visualized if we consider a tube coil of extremely great center distance—say tubes on 5-ft centers—in a poorly insulated ceiling. It is then obvious that heat must flow from the ceiling surface of the heated room to an unheated attic above through such sections of the panel where no tubes are located. This cross flow of heat becomes less important the closer the tubes are spaced.

A multi-layer radiant panel structure—as commonly used is shown in Fig. 9a. Including both its boundary layers, this panel is first reduced to an "equivalent panel" of one constant conductivity, k, throughout, as shown in Fig. 9b. An actual layer of conductance C_L is, as before, replaced by an equivalent layer of thickness $x = \frac{k}{C_L}$. An actual layer x_a inches thick and of conductivity k_a is replaced by an equivalent layer of conductivity k and thickness $x = x_a \frac{k}{k_a}$. If we plot the isotherms and heat flow lines of a small section d of the panel in Fig. 9b and then consider its equivalent gravity and water flow lines, we obtain a temperature gradient as shown in Fig. 10.

A cross section at the actual panel (ceiling) surface is shown in Fig. 11, and indicated by section line "A-A". It may be seen that the temperature of the panel surface directly below (or above) the tube is appreciably higher than that of those parts of the surface located between tubes. This variation of panel surface temperature is greater in panels of (a) great conductivity, and (b) where tubes are buried shallowly, and (c) at large center spacings.

Change of Panel Properties

We will now consider a tube supplied with water of constant temperature in a panel of different materials and different properties. Refer to Fig. 10. First let us assume that we keep all temperatures (water and room) constant and merely add some insulation in the actual panel between tube and opposite room. In our analogy, that would increase the length of the right-hand portion of Fig. 10. Since all temperatures and thereby elevations remain constant, increasing the horizontal length of the right portion is equivalent to decreasing its slope. Consequently, less heat will flow to the right and therefore slightly more heat will be diverted to the left slope of Fig. 10. This leads to the conclusion that: *Adding insulation to the non-heating side of the panel considerably decreases the panel heat loss and slightly increases the panel's output into the room.*

Next let us assume the original panel structure but with a higher temperature in the non-heated room. This lifts the right-hand end of the "gravity hill" of Fig. 10, decreases its slope, and thus results in *less heat loss and slightly greater panel output* to the heated room—a rather obvious conclusion.

ANY QUESTIONS?

The next article of Mr. Vanderweil's series will be the conclusion of the series itself. Following that, the author has consented to attempt to answer questions on radiant heating; these answers will appear subsequent to the final article. In the meantime readers are invited to submit their questions to the Editor, HEATING AND VENTILATING, 148 Lafayette Street, New York 13, N. Y.

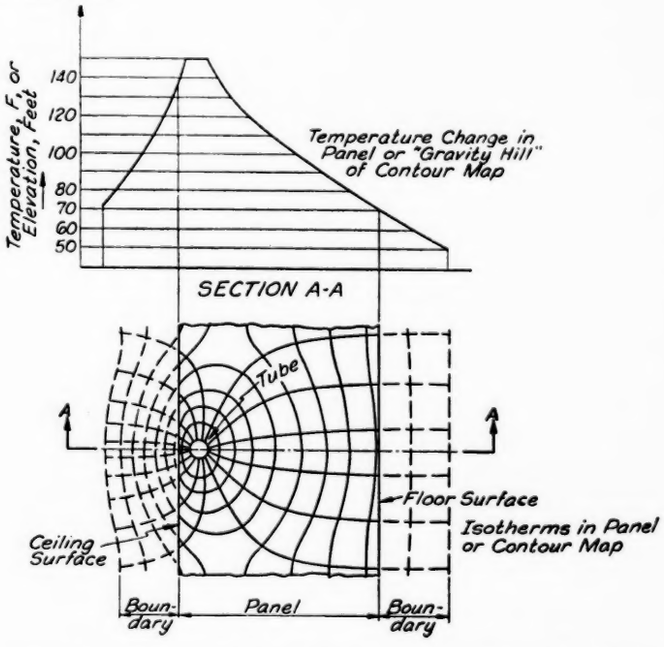

Fig. 10. Temperature gradient in a cross section of the equivalent slab in Fig. 9 and laid on its side.

Let us now assume the original temperatures again, but that material is added between the tube and the heated room (this could be in the form of a heavier plaster layer). Then we are adding to the horizontal length of the left-hand section, decreasing the slope, with consequent reduction of the heat flow in this direction. Therefore, we can say that *increasing the depth of bury of the tube considerably reduces the tube's heat output to the room.*

If the temperature of the heated room decreases (e.g., if windows are opened) then in Fig. 10 the left-hand slope increases and more heat flows into the room. Conclusion: *If the temperature of the heated room drops, the panel output increases.* This self-compensating action is remarkably great with radiant heating.

We assumed that the material surrounding the tubes of Fig. 10 was of a certain conductivity. Let us now replace the panel by one of lower conductivity or higher heat flow resistance. This increases the horizontal length of both sides of Fig. 10 and thereby leads to the conclusion that *identical tube coils operated with identical water temperature result in smaller heat output when embedded in low conductivity materials than in higher conductivity materials.*

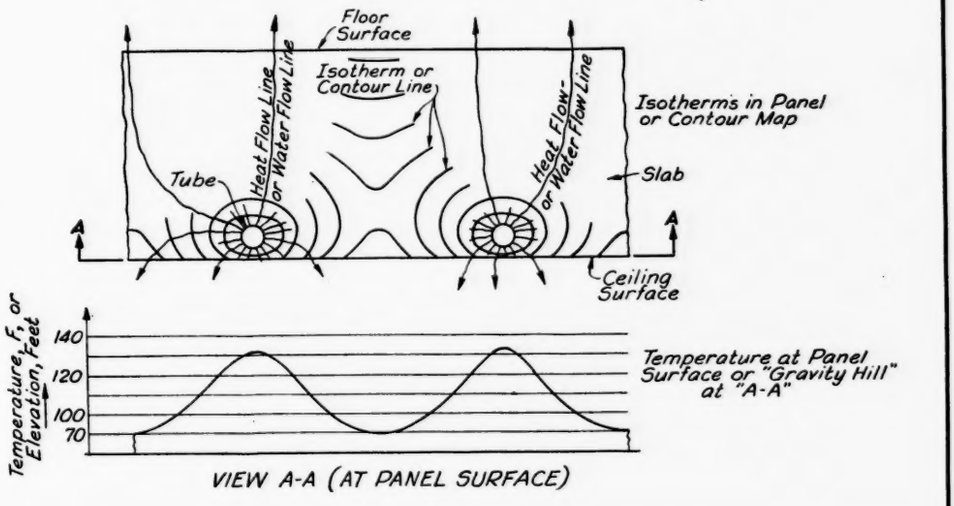

Fig. 11. Cross section through panel and temperature distribution at panel surface.

Computation of Panel Heat Flow

Recapitulating and applying the laws of flow to heat rather than to water, we may state that the panel output to the heated room is affected by (1) temperature of the water in the coil, (2) tube diameter, (3) tube spacing, (4) conductivity of material enclosing the tube, (5) depth of bury of the tube, (6) conductance of panel surface and, to a lesser degree, (7) temperature of the room joining the second (opposed) panel surface, (8) conductivity of the materials between coil and opposite surface, and (9) their depth. Naturally, the panel output is also governed by the temperatures of the room to be heated, as was shown in a previous article.

Fig. 12 shows all these variables. In the sample structure shown in this figure, we see that the "materials between coil and opposite surface" are composed of a concrete section of thickness b_1, and air layer b_2, and a plaster section b_3. When taking a cross section through the concrete beam of Fig. 12 still different conditions are met.

After considering the number of interrelated variables, it will be obvious to the reader why all "simplified methods" did not produce the desired results and that the rational computation method resulted in complex equations. However, these computations were graphically solved and represented in simple graphs.

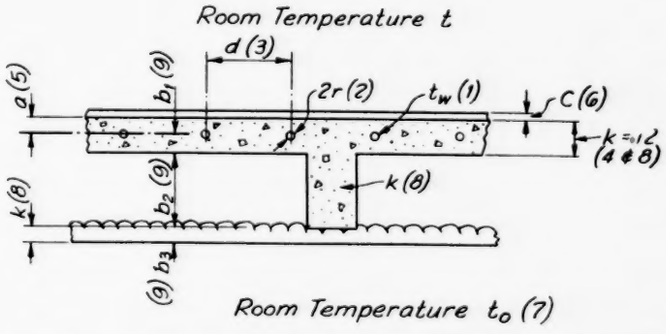

Fig. 12. Showing the numerous variables influencing the output of radiant heating panels.

The next article of this series will briefly explain how the equations for the panel heat flow were derived, show the design graphs, and discuss use of these graphs in a practical example.

Trends in Apartment House Heating

NATHAN N. WOLPERT

Associate Editor, HEATING AND VENTILATING

ENGINEERS throughout the country believe that temperature control is the thing that merits the most attention in apartment house heating.

This prevailing opinion was discovered as the result of a survey among heating and ventilating engineers to determine which phase of apartment house heating is most in need of improvement. The questions asked in this survey are given in the box on this page.

Of the items checked for the first question, and some checked several of those enumerated, 81.5% of the engineers believed temperature control was most in need of improvement in apartment house heating; heat distribution in rooms, 44.6%; fuel burning equipment, 32.3%; piping, 18.4% and domestic hot water, 16.2%.

There is also a feeling that less of the total cost of apartment house construction should be spent for ornate public space and more money should be directed to the heating system and its controls. Some of the comments follow:

Which of the following phases of apartment house practice do you feel is in most need of improvement and why: Fuel burning equipment, piping, service (domestic) hot water, temperature control, heat distribution in rooms?

If you feel that an insufficient amount of total apartment construction costs are allotted to heating, then where do you believe that money might be saved so as to increase the amount spent for heating?

What is your opinion regarding zoning for apartment house heating and to what extent do you believe this feature will be adopted in the heating of apartment houses?

Is there any trend toward adapting radiant heating to apartment house construction in your area?

Utility Engineer, Nebraska: Improvement on temperature control and heat distribution are important, for, from a utility standpoint, it is from these two phases that we receive most of our complaints and calls.

Apartments constructed in our district are built as economically as possible and I doubt if anything can be deducted from the structural costs. I believe that the loaning agencies will have to increase heating allotments for such buildings.

Zoning is very essential for apartments and the utility has been recommending and installing circulated hot water jobs with circuits for each individual apartment or individual forced air furnace.

While up to the present there has been no trend towards adapting radiant heating to apartment houses, there has been some interest expressed recently.

Engineer, Tennessee: At present, fuel burning equipment is too expensive to operate and it produces too much dirt; too much heat is wasted due to overheating rooms.

Omit much of the fancy exterior trimming, which after all is merely a matter of individual taste. Basically it is some architect's idea and it adds nothing to the comfort and health of the occupants. Wholely unnecessary gadgets of doubtful utility could be left out. Some zoning in special instances is advisable but this feature can easily be overdone. I do not believe that it will figure conspicuously in this locality.

I believe other heating methods are better in every way than the use of radiant heat. Comparatively speaking, it is more fanciful than practical.

Engineer, New Jersey: Automatic temperature control is the only way to obtain an even heat and to maintain a proper distribution of heat in each room. It is essential to the health of the residents. Rooms should be zoned according to their use. In other words, bath rooms and bed rooms should be zoned to insure health during sleeping hours.

Construction and landscaping costs could be reduced and the savings directed to heating and temperature control.

There is a slight trend towards radiant heating. However, at present, the installation cost is too high to be considered by apartment house owners.

Dean of Engineering, S.W.: One of the major problems in the designing of homes for the deep south is that by virtue of their training in the north, many architects and engineers design the homes for the long winter periods. In the south we have long summer periods and we try to provide adequate cross ventilation. Housing that is well designed for cross ventilation constitutes a serious heating problem during the winter months, but the cooling problem is paramount. We have many mistakes of homes that were designed to be warm in the winter but are unlivable during the summer.

Engineer, New York: Why is heating the tail of the dog? It is one of the large operating costs and should be so recognized. I consider zoning economical and satisfactory in most cases. It will be favored where the owner intends to operate and not to sell his building.

Engineer, New Jersey: I believe that heating for comfort has not been given the proper consideration by architects and engineers. Not enough money has been allotted for temperature control in the various rooms. Only the proper education of architects and engineers through trade journals and by industry will promote the proper study of zone heating.

There has been no trend toward radiant heating in this area although it is difficult to determine whether builders have given it any consideration. Very few

high rental buildings are being erected. Insurance company financed buildings have not included radiant heating.

Consulting Engineer, Texas: Usually in this area money can be saved in the general contract if the architect designs the building so that there will be no excavating expenses. Zoning is usually impractical as an apartment normally would be in two zones and it would not give satisfactory results for any single apartment. Radiant heating is receiving more attention in all lines of construction.

Engineer, New Jersey: Heating methods in use have been considered "standard" for many years. Construction cost can be saved by paying attention to the size and ornamentation of public space such as the apartment house lobby. Zoning does not go far enough. There should be temperature control of apartments.

Engineer, Kentucky: Individual temperature control is the most needed of any single advancement proposed. Why should any money be saved to insure adequate heating? Zoning should be carried out to provide at least each apartment on one zone. Progressive engineers will consider this a must.

Engineer, Tennessee: Design the heating system and then determine how much could be allowed for luxuries such as elaborate interior decorations, instead of designing an elaborate apartment and then pinch pennies on the heating system. I believe that zoning is satisfactory from all standpoints and I believe it will be more extensively used in the future.

Engineer, New Jersey: There should be automatic control of temperature in each room. This initial cost may be overcome in fuel saving. I believe that the trend is for more individual control.

Apartment Operator, South Dakota: More consideration should be given to individual room control. At present most equipment is too expensive, complicated, and unreliable to appeal to buyers, and it also wastes fuel.

Engineer, New Jersey: An oil burner is needed which does not go on and off continuously. It should be designed to operate with the flame on at all times.

Engineer, New York: The increased efficiency from improved systems should pay for the investment and should liquidate the higher cost in a comparatively few years. I feel that zoning is the only sensible, efficient and comfortable plan of apartment heating.

Engineer, Texas: Temperature control is necessary for health. Allotments for the heating system can be increased by eliminating unnecessary ornamentation in rooms and on building exterior. Zoning is economical and is more efficient.

Engineer, New Jersey: Improvement in apartment house management is important. More money should be available for heating systems, and the system should be zoned.

Engineer, Tennessee: Our usual apartment house is not excessive in exterior decoration and is rather plain on the inside. Zoning will save fuel, add comfort.

Engineer, Kentucky: I believe that zoning is the most important item to stress in new apartment buildings.

Engineer, Texas: If proper heating is installed, money will be saved on fuel bills. In the south, an unbelievable amount would be saved in maintenance alone. Each apartment should be zoned so that each apartment can control its own temperature. If this is accomplished, I do not believe it is necessary to add additional expensive zoning controls.

Here in the south, I see no trend for radiant heating in apartment houses. Because of the 5½ months of summer, the need for summer air conditioning is so great that forced air heating with the possibilities of adding air conditioning exceeds radiant heating.

Engineer, New Jersey: More money could be provided for heating by having a little less show in apartment buildings. Zoning has advantages but most apartment house owners will not use it unless the fuel saving will pay for all or most of the cost of this improvement.

Engineer, Rhode Island: Build within the money limits but set aside a greater percentage of the building cost for heating. Heat is the "heart and soul" of a building. Zoning should be adopted.

Engineer, New Jersey: I am frankly old fashioned in my approach to this problem. The heating plant can only be satisfactory to the user if it is skillfully installed. When insufficient funds are allotted for heating, then the heating system must suffer through inadequate equipment. Savings in structural cost can only be made through simplicity of design.

I regard zoning for apartment house heating to be economical in operation and of great satisfaction to the house occupant in heating comfort. The trend is toward the adoption of zoning.

Engineer, Nebraska: While zoning is very essential, the cost is somewhat high for most installations.

Engineer, New York: Some thought should be given to the rehabilitation of present cold water apartments. Zoning would be effective as a fuel saver. This was demonstrated during the war in army hospitals at Fort Dix, Camp Kilmer and the Rome Hospital. In these hospitals zoning resulted in a fuel saving of 25 to 40%.

Engineer, Tennessee: Heating has consistently been the goat when construction costs had to be lowered. Zoning is of secondary importance. Proper design and temperature control are more important.

Engineer, Kansas: All apartments should have zoning for it is an excellent practice.

Heating Contractor, Kansas: The added cost of proper heating will be more than compensated for during the life of the apartment.

Engineer, New York: Money will be saved only through a reduction in operating costs and not in original allocation of costs. There is a need for zoning.

Engineer, Rhode Island: Circulated hot water with zone control is being used much more extensively.

Engineer, New York: Either extensive zoning or individual automatic control is vitally needed. It offers comfort and fuel economy. It will only be adopted, however, under pressure from the designers who usually take the path of least resistance.

Engineer, New York: I believe zoning to be practical in large apartment buildings.

Engineer, Kansas: My personal preference is the use of hot water and the zoning of each apartment.

Graphical Determination of Heat Transfer Film Coefficient for Liquid Freon-22*

B. F. RABER** and F. W. HUTCHINSON***

THE graphical solutions presented in this installment of the heat transfer series[1] give the film coefficients for *liquid* Freon-22 flowing inside (Fig. 15) or outside (Fig. 16) a single pipe. The graphs are constructed from the equations given in the first article and are of the same form as the fourteen preceding graphical solutions of the series.

In one respect, however, they indicate a condition that has not previously been observed, hence require explanation: for refrigerant either inside or outside a single pipe the film coefficient of heat transfer is observed to increase with decreasing temperature from 100F to 25F, but to *decrease* with decreasing temperatures below 25F. Thus for liquid inside a pipe, and heating, the coefficient at 0F has dropped to a value slightly less than that for 75F, whereas for a liquid inside a pipe, and cooling, the film coefficient at 0F has decreased to a value less than that for 50F, but greater than for 75F. This condition requires some explanation: and an understanding of it can best be obtained by reference to the fundamental equation.

As stated in the first article of this series the film coefficient for liquid heating inside a single pipe can be determined from the Nusselt equation,

$$hD/k = 0.0225\ (DG/\mu)^{.8}\ (c_p\mu/k)^{.4}$$

which simplifies to the dimensional form,

$$h = 0.0225\ (V^{.8})\ (D^{-.2})\ (\rho^{.8}k^{.6}c_p{}^{.4}\mu^{-.4})$$

in which V, D, ρ, k, c_p, μ are, respectively, the fluid velocity in feet per second, pipe diameter in feet, density in pounds per cubic foot, thermal conductivity in Btu per (hr) (sq ft) (F per ft), specific heat, and viscosity in pounds per hour per foot. Fig. *A* shows a plotting for each of the three parenthetical terms for a condition of fixed pipe diameter and fixed flow velocity. No ordinate scales are given in the figure since its purpose is merely to indicate the manner in which each exponential term varies with temperature. The resultant curve for the inside film coefficient, h_i, as a function of temperature, shows very clearly the way in which this term increases with decreasing temperature to a maximum value at a temperature slightly greater than 25F; as the temperature is reduced below this value the film coefficient rapidly falls off so that at 0F its value is somewhat less than that for 75F.

Example: Freon-22, in liquid form, is flowing outside and normal to a single pipe at a temperature of 0F and with a velocity of 6½ fps. The pipe has an inside diameter of 3.00 in. and an outside diameter of 3.25 in. Within the pipe Freon-22 is flowing at a mean temperature of 78F and with a velocity of 3 fps.

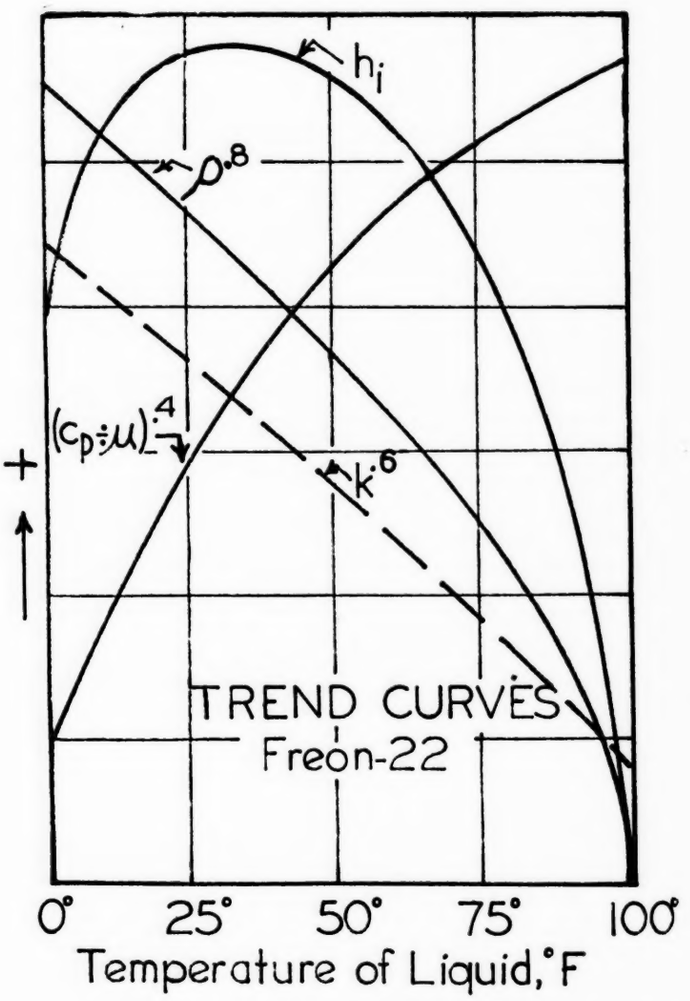

Fig. A. A curve for the inside film coefficient as a function of temperature showing how this term increases, then sharply decreases, resulting in seeming inconsistency of scale in the upper part of Fig. 15 and 16.

Neglecting the thermal resistance of the pipe wall and taking both inside and outside fluid temperatures as mean values, determine the necessary length of pipe to achieve a transfer of energy to the fluid outside the pipe at a rate of 10,000 Btu per hr.

Solution: Enter Fig. 15 at the known inside velocity of 3 fps, rise to intersect the horizontal for inside pipe diameter of 3.00 in., follow the directrix line up to in-

*Freon is a copyrighted trade name held by Kinetic Chemicals Co.

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[1]Previous articles appeared in HEATING AND VENTILATING for Dec. '44; Jan., Feb., Mar., April, June '45; April '46.

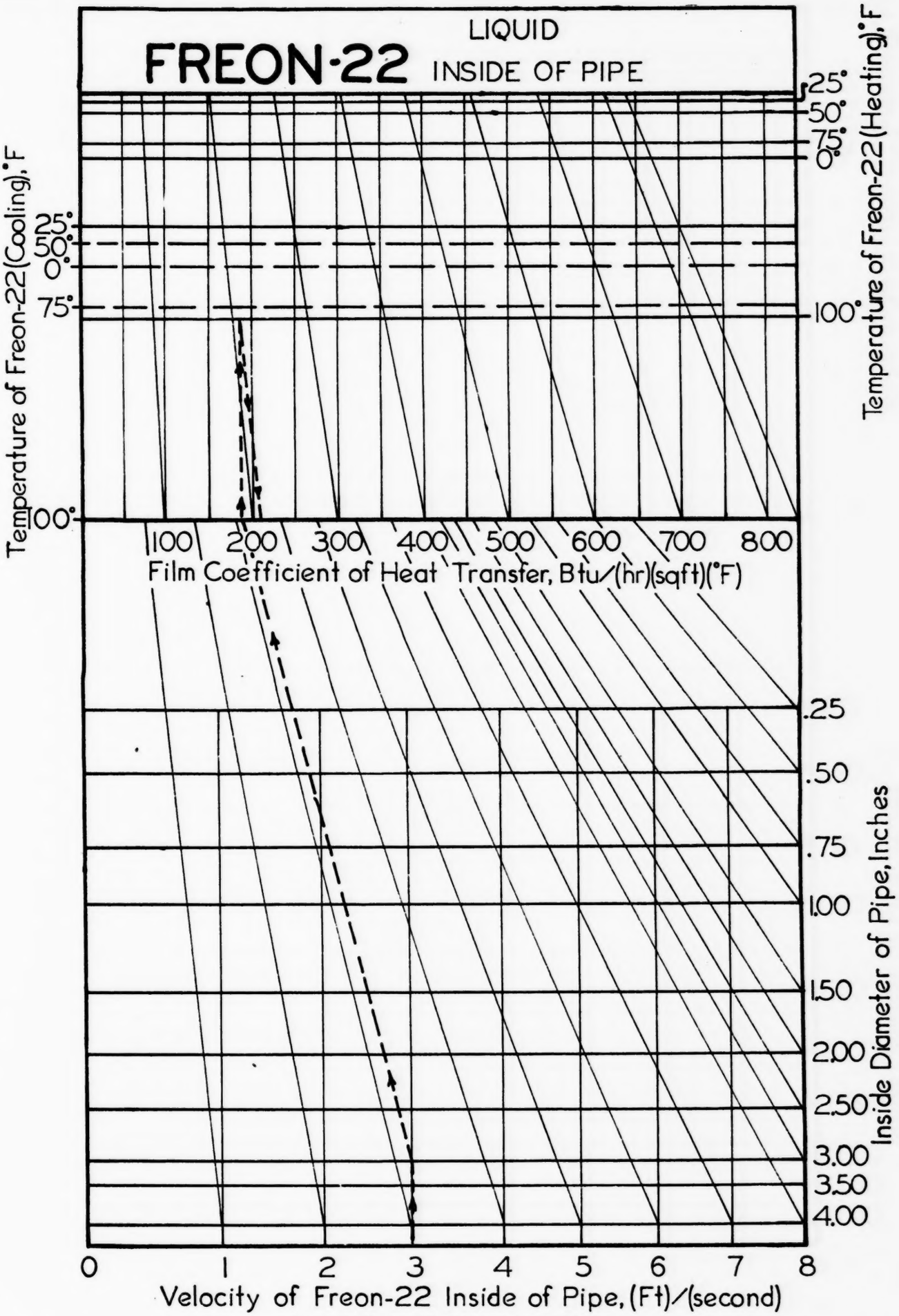

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Fig. 15. Film coefficient for liquid Freon-22 flowing inside a pipe. Refer to text for explanation of apparent inconsistency of scales in the upper part of curve.

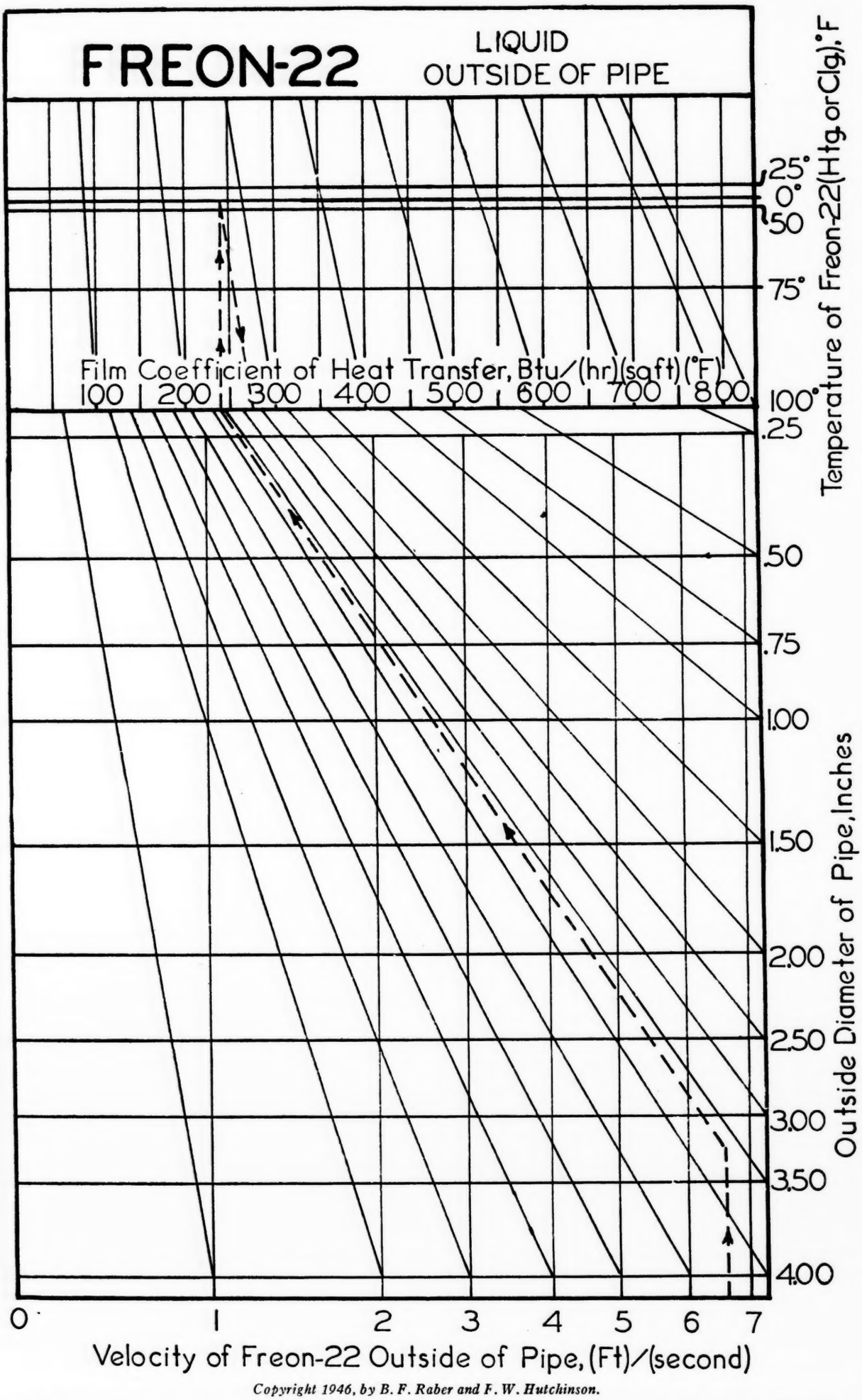

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Fig. 16. Film coefficient for liquid Freon-22 flowing outside a pipe. Refer to text for explanation of apparent inconsistency of scales in the upper part of curve.

tersection with the base scale for the film coefficient of heat transfer; rise vertically from this scale to intersect the horizontal for fluid cooling at 78F, then return down along a directrix line to intersect the base scale at the value of the internal film coefficient, 208 Btu per hr per sq ft per F. Similarly, enter Fig. 16 at a velocity of 6½ fps, rise to the external pipe diameter of 3.25 inches, follow directrix to intersection with base scale; from the base scale rise vertically to intersect the horizontal for fluid at 0F (noting that for fluid outside the pipe the temperature lines are valid irrespective of whether the material is being heated or cooled) and then return downward along a directrix line to intersect the base scale and read the answer as 270 Btu per hr per sq ft per F for the outside film coefficient.

The respective film resistances for this case are then $1/208 = 0.0048$ and $1/270 = 0.0037$ and the overall resistance, neglecting that of the pipe wall, is $0.0048 + 0.0037 = 0.0085$. The overall coefficient of heat transfer is therefore $1/0.0085 = 118$ Btu per hr per sq ft per F. The average temperature difference between the two fluid masses is $78 - 0 = 78$F. The area of a lineal foot of 3 in. pipe (conservatively calculating surface area on the basis of inside rather than average diameter) is $\pi\ (3/12) = 0.79$ sq ft. Then solving for the required length, L, we have,

$$10{,}000 = 118 \times 78 \times (0.79L)$$

or

$$L = 10{,}000/(118 \times 78 \times 0.79) = 1.37 \text{ ft, say 2 ft}$$

of pipe.

For actual problems of this type the resistance of the pipe wall would not be neglected. Resistances for standard copper tubing and for iron pipe have been given in tables appearing as part of earlier articles of this series.

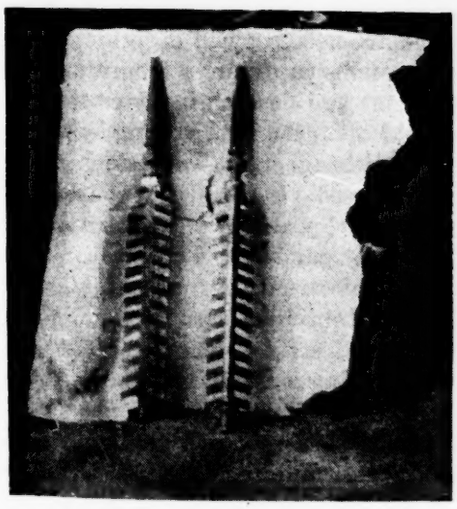
Grate Bars Can Be Repaired By Welding

Our Company operates 18 locomotives, 4 steam draglines, and 5 steam shovels, representing almost as many different makes. All of this equipment is equipped with grates fabricated in our welding shop from mild steel plates and standard shapes. This includes round bars, square bars, flat washers, etc.

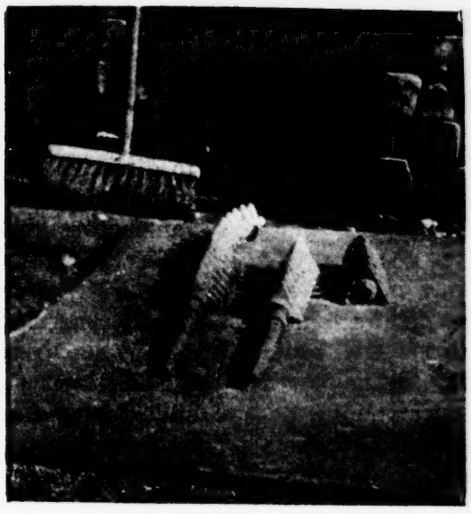
Some of these grates have been in service over six years, and of the entire output of our shop, only three grates have come back. And this was the result of negligence on the part of a watchman who fired a steam crane and neglected to dump the ashes. As a consequence the grates were badly bowed. However, all that was necessary to repair them was to replace three teeth in the middle section on one grate after it was straightened. The straightening was accomplished by merely placing the grate on a flat piece of steel with the bowed side up and striking a few blows with a sledge hammer.

Imagine trying to do this to a cast iron grate such as the one in the photo. It can't be done! The cast iron grates are a total loss, and this includes the cast iron grates that are straight but broken, as they cannot be successfully welded even with gas.

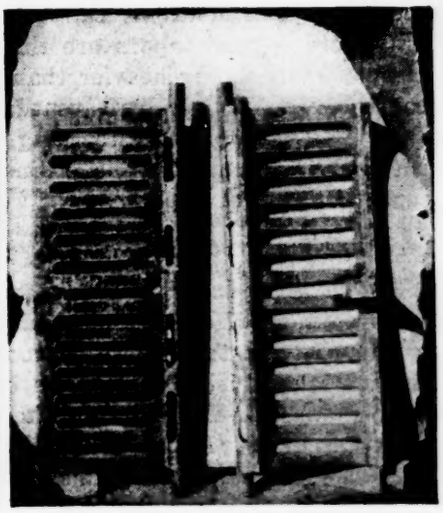
A set of six grates of the locomotive type can be turned out by one welder and a helper in an eight-hour day. The initial cost is slightly less than cast iron grates but, nevertheless, if the welded grates cost twice as much as the cast iron grates, it would still be like getting them for nothing as we had been putting in a new set of cast iron grates in each unit on an average of once every three months.—*Norman E. Smith, Illinois; a prize-winning story in the Hobart arc welding news contest.*



Heating furnace grates flame cut and arc welded.



Cast iron heating furnace grates showing warpage and breakage.



Back and front view of two replacement locomotive dump grates completely flame cut and arc welded.

Accidents Involving Ventilating Equipment

L. W. HUTCHINS
Managing Director, Safety Research Institute,
New York, N. Y.

ACCIDENTS involving ventilating equipment may occur as the result of faulty design, installation, operation, and repair of these units.

Errors in the design of ventilating equipment installed to protect workers from air contaminants or flammable vapors can be serious, since the fault often is not suspected or detected until illness or fire has resulted.

Lack of Make-Up Air

One of the more common faults in design is failure to provide an adequate intake for make-up air. During warm weather, when open doors and windows serve this purpose, the defect may not be apparent and the unit will function satisfactorily. But lower temperatures may change the story. A typical accident of this kind occurred in a paint room housing 16 paint spray booths and a gas-heated baking oven, all of which discharged to the outside air. The spray booths were equipped with mechanical exhaust fans; the gases generated in the oven were discharged by thermal propulsion. On the first cold autumn day, when windows and doors had to be closed, the oven exhaust stack became the air intake, and combustion gases, solvent vapors, and decomposition products poured from the oven's conveyor entrances and fire doors. The room became uninhabitable and production had to be discontinued until the defect in the system was corrected.

Some ventilating accidents are traceable to exhaust systems designed to draw air upward through the workroom and discharge it at the ceiling. This system, while effective in most simple heating or air-conditioning installations, can cause serious poisonings where solvent vapors are the air contaminants. Solvent vapors, being heavier than air, tend to settle near the floor and up-draft ventilation carries these vapors into the worker's breathing zone. Local down-draft exhaust ventilation is ordinarily desirable for removal of solvent vapors.

Recirculation of Solvent Vapors

Another error in design which results in accidents is recirculation of contaminated air, as in the following instance. In the inspection room of a California plant, metal precision parts were being cleaned with a chlorinated solvent and calibrated with a high degree of accuracy. It was found that these parts corroded rapidly and, at the same time, employees complained of illness and nausea. Careful investigation proved that the design of the ventilating system was responsible. The air-conditioning unit recirculated the room air through a cooling unit. As the day progressed the solvent vapors became more and more concentrated, and contamination finally reached a concentration sufficiently high to ruin the product and make the workers ill.

Recirculation of air is almost never practicable where gases and chemical vapors may be in the atmosphere. Filters and spray-washing remove dust and other particulate matter, but they are not effective against volatile contaminants.

Failure of a ventilating system is often attributable to an attempt to extend the system beyond its effective capacity; and even where such extension does not tax the system's capacity, it may introduce new and dangerous factors. An industrial hygienist relates about a plant in which the exhaust system for some small coupling barrels was extended to include some pickling tanks as well. The fan was a multi-blade high pressure exhauster, rather than a material handling type, with the result that the blades were rapidly covered with dust. Acid vapors from the pickling tanks reacted with zinc fumes rising from the coupling tanks to produce a zinc chloride syrup that soon coated the fan blades with a heavy "cement" of dust and chemicals. The system was permitted to run in this condition for about six months, during which time the acid spray from the pickling tanks, not having been properly dispersed from the atmosphere, destroyed all the exposed metal parts in the room as well as some of the structural steel members of the building itself.

Precaution Against Fires

Where flammable solvents are to be used, the most stringent precautions are necessary in designing heating and ventilating systems in order to insure against the possibility of violent and destructive fires and explosions. There should be automatic venting windows to diminish structural damage from explosions wherever such solvents are used. In addition, sparkproof fan motors should be employed and the entire ventilating system should be grounded to help prevent the accumulation of static electricity which might give rise to sparks. Tanks containing flammable liquids and vapors should be vented directly outdoors.

Sometimes the ventilating system may be responsible for spreading a minor fire. Thus, a fire started by defective wiring in a theatre booth on the second floor of a theatre and office building extended through the air conditioning ducts to the roof, resulting in $75,000 loss. Provision of fire stops and automatic shut-off of the ventilating system in case of fire can be a valuable means of preventing such accidents.

Despite the fact that properly designed installations can be economical in fuel consumption, the ventilating system is sometimes shut down to conserve fuel. Where dusty processes are involved, the resultant contamination of the atmosphere usually becomes noticeable before any serious damage is done. But where toxic gases and solvent vapors are involved, since they are invisible and their odors not always detectable, serious illness or even death may occur before it is known that the ventilating system is not in operation.

When ventilation trouble is reported, tests show that the installation is in good condition and should be operating effectively, it is desirable to take samples of the air and to test them for the contaminant. Air samples should be taken in various breathing zones and at different stages in the processes carried out in the workroom. Frequently this is the only way of detecting that the ventilation system has been turned off, or that there is some basic error in design. Some plants make such tests a routine part of the inspection procedures of maintenance or ventilating engineers.

Accidents which occur in assembling and installing ventilating units, while not as dramatic as those resulting from errors in design, are nevertheless common enough to merit consideration. Bad housekeeping, poor work procedures, and failure to use protective gloves and safety shoes often result in injuries to installation workers. Pieces of pipe are left on the floor where they cause serious falls; sheet metal is handled without gloves; feet unprotected by safety shoes are injured by the fall of heavy materials.

Repairs to ventilating systems also produce unfortunate and avoidable accidents. A workman crawled into an overhead duct to make repairs only to have the duct collapse under his weight. Another workman lost his left index finger when he stuck his hand in front of a fan; a repair man had forgotten to replace the guard on the fan when he finished his work.

Where repair men may be subjected to unsafe atmospheres, they should, of course, be provided with respirators. The tragedy that resulted when one man overlooked this precaution is a forceful reminder of its importance. A carbon dioxide air conditioning system developed a leak in a basement room, and enough gas escaped to make the atmosphere deficient in oxygen. The man, unprotected, went into the room to shut off the valve, was overcome, and died.

As a means of forestalling breakdowns and accidents, installations should be inspected and tested regularly. Vents, filters and screens must be kept clean and free of oil, dust, and lint to guard against fire and to insure efficient operation. When necessary repairs are undertaken, the entire system should be emptied of vapors and filled with fresh air so that there will be no danger of a workman suffocating in a gas-filled duct.

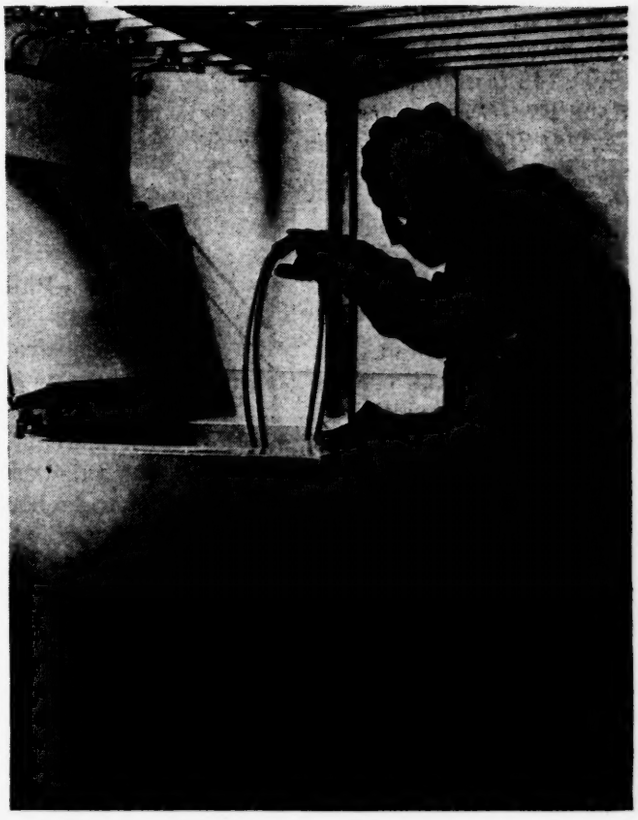
New Cold Room Reaches —90 F

A new cold room in which rubber and synthetic rubber compounds and products of many types, plastics and other materials can be tested at temperatures down to —90F (90 below zero) has been installed by The B. F. Goodrich Company at its Akron, Ohio, plant. Temperatures in the cold room can be varied from 50 above to 90 below zero Fahrenheit.

Thirty feet long, 15 feet wide, the cold room has five working units, each six feet square, cooled by a three stage compressor unit and a single stage compressor using Freon 12 and 22 as refrigerants. Each unit operates separately, with electrically controlled temperatures charted for a 24-hour study at different levels.

The new unit is large enough to permit tests of equipment under temperatures found in the colder parts of the United States and Canada, as well as those encountered in high altitude flying.

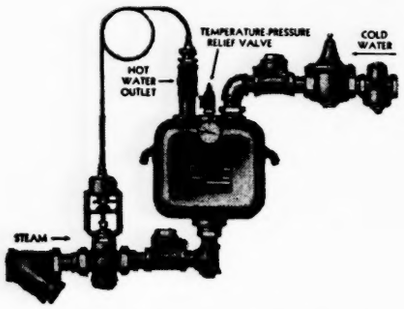
Capable of taking a load of 250 pounds of rubber, synthetic rubber or plastics, 500 pounds of steel or 100 pounds of oil, each unit is equipped with a door having a non-locking catch, and an alarm operated from within the unit as further protection against locking in the operator. All operators wear electrically heated clothing. Four of the units have temperature ranges from 50 above to 65 degrees below zero, while the fifth has a range from 50 to 90 below.



NEWS OF EQUIPMENT AND MATERIALS

Packaged Water Heater

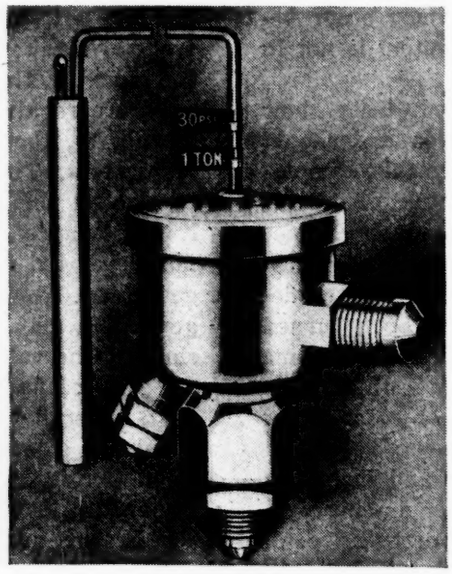
NAME—O'Brien steam mixer water heater.
PURPOSE—Packaged unit for providing domestic hot water.
FEATURES — Designed for steam pressures for 50 to 150 lb per sq in. The unit diffuses steam with the water to produce a large amount of domestic hot water. Instead of being installed in the boiler room unit can be placed at a control point near the point of use. A muffler-type diffuser is said to eliminate the excessive noise that has been



part of direct mixing of steam and cold water. Unit is complete with automatic temperature pressure controls, safety relief valve and thermometer.
SIZE AND CAPACITY—600 to 5,500 gallons per hour at 100F temperature rise. Standard temperature ranges from 100 to 140F, 120 to 160F, 140 to 180F, and 160 to 200F.
MADE BY—*O'Brien Steam Specialty Co., 331 Hefferman Building, Syracuse 2, N. Y.* 1

Thermostatic Valve

NAME—Thermo-limit.
PURPOSE—General use as thermostatic expansion valve.
FEATURES—Made for commercial refrigeration applications of from ¼ to 1½ tons. Unit has what is termed a pressure limiting cartridge which consists of a pressure-charged bellows, a valve push pin, and a spring, and partially takes the place of a cage assembly in the more conventional thermo-valve. Cartridges are available charged to a predetermined pressure such as 10, 15, 30, 45, or 55 lb per sq in. and are interchangeable. Operating parts are also interchangeable. Super heat adjuster is external and does not affect the pressure limit setting.



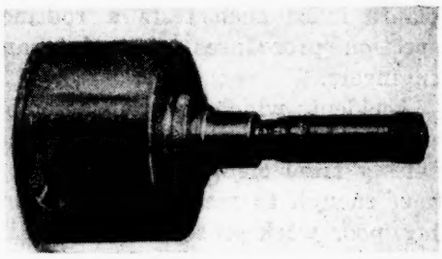
OPERATION — Excessive pressure built up in the low side of the system during the off-cycle reacts in the cartridge bellows and closes the valve when the predetermined evaporator pressure is reached. When compressor starts, the valve remains closed until the evaporative pressure is reduced below the valve setting. As the pressure is further reduced, the valve starts to open and gradually shifts from pressure control to superheat control.
MADE BY—*Alco Valve Co., 865 Kingsland Ave., St. Louis 5, Mo.*.....2

Thermometer

NAME—Philadelphia Industrial.
PURPOSE—Thermometer with easy-reading graduations.
FEATURES—Tube is elliptical in shape with a bore so placed that the mercury column is magnified to the full width of the tube. A yellow tube back, equal in width to the mercury column and visible only for the zone above the mercury level, forms a sharp contrast to the point of temperature reading. Thermometer cases and frames are designed to admit maximum level to both tube and calibrated scale.
MADE BY—*Philadelphia Thermometer Co., 4401 N. 6th St., Philadelphia, Pa.* 3

Micrometer Valves

NAME—Microl valve.
PURPOSE—Precision flow control.
FEATURES—The equivalent of 600 in. of capillary passage are enclosed in a metal container 1½ in. square. Flow control follows the moving of an adjustable plunger which varies the length of capillary passage from 400 to 600 in. Valves are made of non-corrosive metal. Flow of air and gases may be varied over a range from 0.2 to 60 cu in. per minute with a pressure drop across the valve of 15 lb per sq in.



MADE BY—*Standard Instruments Co., 15 Elkins St., S. Boston.* 4

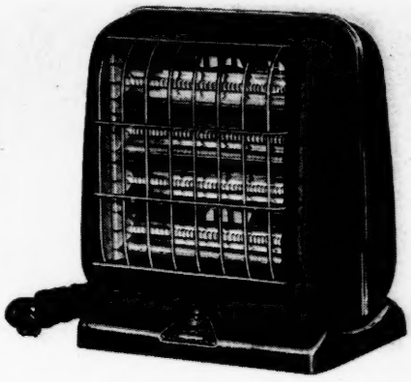
Coupling

NAME—Coupling for Spiratube.
PURPOSE—Rapid means for connecting sections of flexible Spiratube.
FEATURES—Coupling has a slat spring steel collar that may be compressed to slip inside the end of another section and then released to form a strong tight joint. Is disconnected by pressing the inner steel spring collar and withdrawing the male end. Couplings are covered with duck fabric that has been processed with a tough thermo-plastic. There are no exposed metal parts to the coupling.

MADE BY—*Spiratube Division, The Warner Bros. Co., Dept. 3, Bridgeport 1, Conn.* 5

Portable Heater

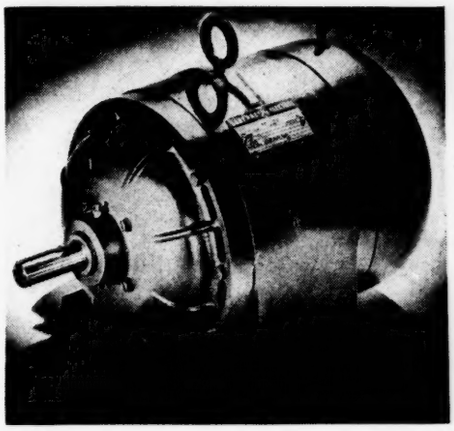
NAME—Emerson electric combination radiant and fan type heater.
PURPOSE—Portable unit for room heating.
FEATURES—Unit has capacity of 4275 Btu per hr and the fan moves 150 cfm over the heating surface. There are four heating elements in front of the concave chromium plated heat reflector. Heater has an adjustable mounting for tilting up or down within an arc of 40 degrees. Snap-on guard permits easy access for cleaning reflector. Unit is provided with an 8 in. fan and slow speed rubber mounted



motor. Complete unit weighs 11 lb.
MADE BY—*Emerson Electric Mfg. Co., St. Louis, Mo.* 6

Fan Cooled Motor

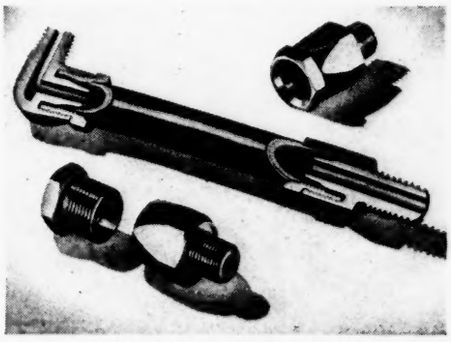
NAME—Fan cooled Tri-Clad induction motor.
PURPOSE—A fan cooled motor designed for use in dusty, dirty and corrosive atmospheres.
FEATURES — Motor is explosion-proof and dust explosion-proof and is said to be suitable for hazardous locations. Motor has a double shell cast iron frame, and cast iron end shields and conduit box for protection from injury and vapors. A rotating seal prevents dirt from entering the motor along the shaft. Punchings and windings within the inner shell of the motor are cooled by a non-sparking external fan which is protected by a cast-iron housing with a screened air-intake opening. Cast iron bearing housings are cast integral with the end shields as a barrier to the entrance of foreign materials. Motor requires low starting current and thus requires simple, inexpensive control equipment. It has high pull-



up torque and a high maximum running torque.
SIZE AND CAPACITY—1 to 1000 horsepower.
MADE BY—*General Electric Co., Schenectady, N. Y.* 7

Hose Couplings

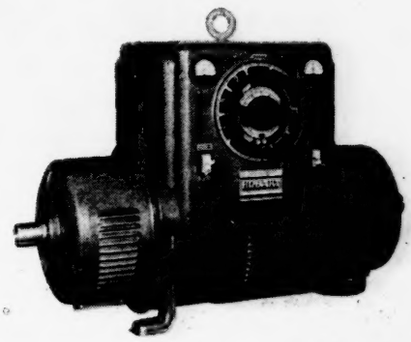
NAME—Resistoflex reusable metal couplings.
PURPOSE—Safety-seal couplings for use with a flexible hoseline.
FEATURES—Couplings can be easily



attached or detached and can be used over again with end-wrench assembly in the field. Coupling nut threads onto the hose and the coupling shell compresses the hose end into a safety-seal gasket. Fitting has a long even grip on the hose and the double bell shape of nut permits the hose to flex without cutting it. Large square wrench surfaces make assembly operation easy.
MADE BY—*Resistoflex Corp., Belleville, N. J.* 8

Motor Welder

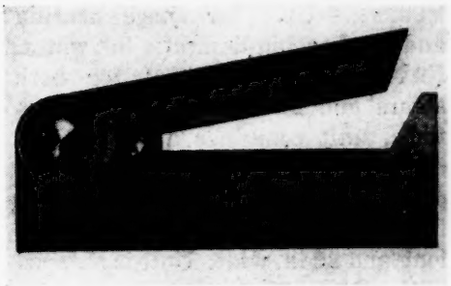
NAME—Hobart electric drive.
PURPOSE—For general welding.
FEATURES—Unit is designed to be started across the line and to automatically synchronize itself by the build up of a separate exciter. Starting current is approximately the same as a conventional induction motor of the same horsepower capacity. Motor is the Hobart revolving synchronous type and is provided with heavy squirrel cage winding to make easy starting. Once up to speed, the exciter builds



up and automatically applies correct excitation to motor field.
MADE BY—*The Hobart Brothers Co., Hobart Sq., Troy, O.* 9

Drafting Instrument

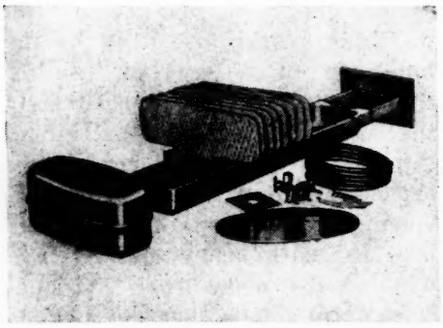
NAME—S & J quadrangle.
PURPOSE—Drafting instrument.
FEATURES—Instrument makes possible finding of angles from 0 to 90 degrees, pitch scales from 0 to 24/12; percentage slopes from 0 to



100%, sine or cosine functions, and tangents. Instrument has 8 drawing edges and may be used as a triangle. Overall size, 4 x 11 in.
MADE BY—*Stewart-Jackson Instrument Co., A. G. Bartlett Bldg., Los Angeles 14, Calif.* 10

Humidifier

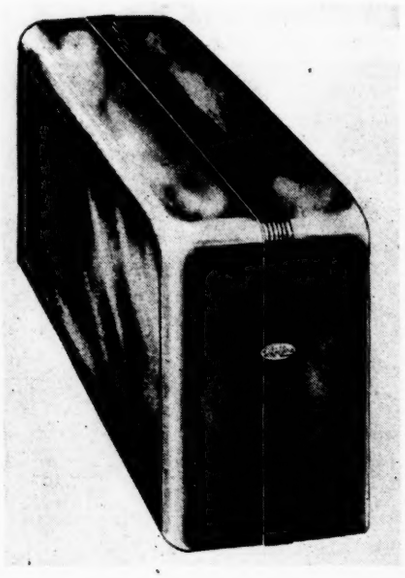
NAME—Viking Series 1100 plate type humidifier.



PURPOSE — Air humidification in connection with warm air furnaces.
FEATURES—The absorbent evaporators are supported in a frame in a narrow evaporator pan which fits into bonnet or plenum of furnace. It may be installed in either the sloping bonnet or converted gravity furnace or on a straight side plenum. Adjustable mounting slide enables it to fit into any width of plenum or diameter of bonnet. A copper float valve is located outside the furnace and automatically keeps the water pan full at all times. Evaporator pan is made of copper, die-stamped from one piece. Complete unit consists of a coil of copper tubing, evaporator plates and rack, saddle valve and access panel.
MADE BY—*Viking Air Conditioning Corp., 5600 Walworth Ave., Cleveland 2, Ohio.* 11

Heating Unit

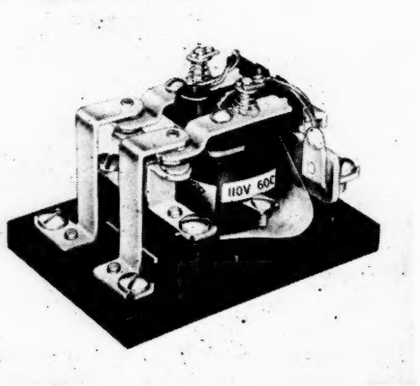
NAME—Whirl-O-Matic.
PURPOSE—Unit for space heating and for heating domestic hot water.
FEATURES—Designed for both steam and hot water heating systems, unit combines a boiler, fuel oil burner and factory installed combustion controls in a streamlined cabinet 36 in. high, 42 in. long and 22 in. wide. Unit is shipped with all necessary parts so that installation is simplified. Among parts supplied are Minneapolis-Honeywell controls, low water cutoff, central flame tube, 3-pass horizontal high pressure steam unit, flash boiler and hot water coils. Makers claim that this unit will produce heat and hot water instantaneously at high overall efficiencies.



MADE BY—*Persiro Mfg. Corp., 38 Keer Ave., Newark 8, N. J.* 12

Power Relay

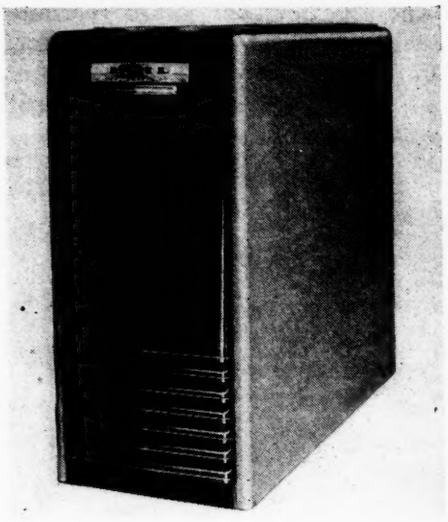
NAME—Type PR-8 power relay.
PURPOSE—For power circuits such as motor starting and heater loads.
FEATURES—All insulation is molded or laminated bakelite with coils layer wound on insulating bobbins and baked varnish impregnated. A heavy return spring provides



snap action. Since coil operates on as little as 3 watts, makers say that it is ideal for use with thermostats or other devices with delicate contacts. Silver contact points 5/16 in. dia are rated at 15 amp non-inductive load at 110 volts a-c. AC types are copper shaded.
MADE BY — *Potter & Brumfield Sales Co., Dept. 247, 549 W. Washington Blvd., Chicago 6, Ill.* 13

Oil Fired Furnace

NAME—Heil furnace burner unit.
PURPOSE—For general heating.
FEATURES—Blower and motor is located on the unit base to reduce noise. Adjustable pulleys and V-belt drives simplify servicing. Automatic humidifiers on furnace burner units are accessible for servicing. Unit has copper alloy steel heat exchangers. Jackets are insulated to prevent heat loss and



have radiused corners with interlocking panels.
SIZE AND CAPACITY—Model VF-1 and UF-1 have outputs of 60,000 Btu per hr; series KF has outputs of 85,000, 110,000 and 300,000 Btu per hr.
MADE BY—*The Heil Co., 3000 W. Montana St., Milwaukee 1, Wis.*...14

Pressure Gauge

NAME—Low range pressure gauge.
PURPOSE — Measurement of low range pressures.
FEATURES—Pressure element is a self-draining bronze bellows with a phosphor bronze calibration spring. Adjustable stops protect the bellows from excess pressure or vacuum. Gauge comes in 4½ in. and 6 in. phenol cases with ¼ in. male pipe thread.
SIZES AND CAPACITIES—Type 1188 P in pressure range from 10 in. water to 10 lb pressure. Type 1188 V in vacuum ranges from 10 in. water to 20 in. mercury vacuum.
MADE BY — *Manning, Maxwell & Moore, Inc., Bridgeport 2, Ct.* 15

Three-Way Valve

NAME—Grove Flex-tube three-way valve.

PURPOSE—For handling gases, chemicals and liquids.

FEATURES—Valve has unrestricted straight flow characteristics and is said to be satisfactory for controlling viscous or solid carrying fluids. Non-metallic construction enables it to handle corrosive or erosive liquids and gases. Manual operation is by means of a centered cam which opens and closes the ports, at each half turn of the hand wheel. A self-locking feature assures positive tight shut-off over extended periods of time. It is furnished for working pressures up to 250 lb per sq in. and maximum temperatures of 150F.

LITERATURE AVAILABLE—Bulletin FT-1.

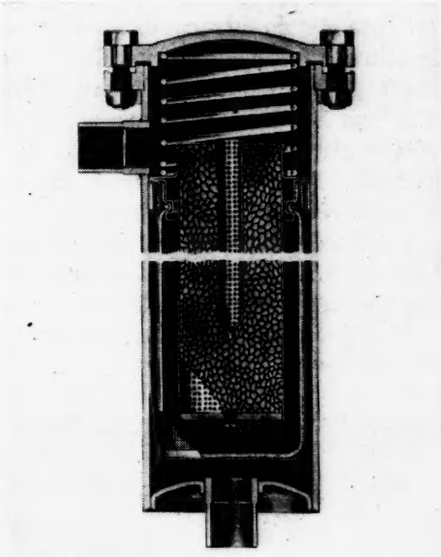
MADE BY—*Grove Regulator Co., 65th and Hollis Sts., Oakland 8, Calif.* 16

Filter-Drier

NAME—Combination strainer-filter-drier.

PURPOSE—For use with mobile refrigeration installations, particularly for railroad cars and automobile trucks.

FEATURES—Filter is locked on dehydrant cartridge by means of a snap ring and the filter-drier assembly is held in place by a compressed spring. Dehydrator is readily renewed with a factory-sealed cartridge that has an inlet dispersion tube which prevents channeling of refrigerant through drying agent. Shell diameter is 3⅛ in. and screen area 136 sq. in.



This size is recommended for systems up to and including 5 hp. Unit is shipped with inlet and outlet ports sealed with soft-soldered caps to protect interior from moisture and dirt. Standard drying agent is silica gel although other dehydrants can be supplied on special order. Tube connections are ⅝ in. and ¾ in. O.D.

MADE BY—*Henry Valve Co., 3260 W. Grand Ave., Chicago 51, Ill.*.....17

Tap Extractor

NAME—Walton tap extractor.

PURPOSE—Removal of broken pipe threading taps.

FEATURES—Ten tap extractors are designed for hand and machine screw taps. They are made in all sizes of pipe taps from ⅛ to 1 in. inclusive and for both regular and interrupted thread styles.

MADE BY—*The Walton Co., 94 Allyn St., Hartford 3, Conn.* 18

Warm Air Heater

NAME—GB warm air heater.

PURPOSE—For space heating.

FEATURES—Makers claim that unit has an overall efficiency rating of 82%. A tray filter removes dust and dirt from circulating air and an automatically controlled humidifier regulates humidity. Unit has an oil level control valve that meters the correct amount of fuel to the burner and a thermostatic fan switch which assures circulation of the heated air. There is also a delayed action switch which provides an overrun of the burner booster fan after the heater shuts down. This purges the heat exchanger of unburned gases. Unit will be available in both oil-pilot and electric ignition models.

SIZES AND CAPACITIES—Made in two sizes. Small size has capacity of 55,000 Btu per hr and is designed to meet the needs of homes of not over five rooms; larger unit has capacity of 110,000 Btu per hr.

MADE BY—*General Bronze Corp., 34-19 10th St., Long Island City, N. Y.* 19

Water Cooler

NAME—Sunroc little giant.

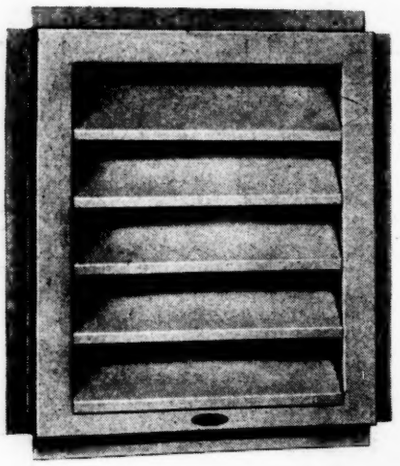
PURPOSE—For cooling water.

FEATURES—This small sized unit has capacity of 5 gal of cooled drinking water per hour without the necessity of precooling and is available with either hermetically sealed or conventional unit.

MADE BY—*The Sunroc Refrigeration Co., Glen Riddle, Pa.* 20

Residence Attic Louver

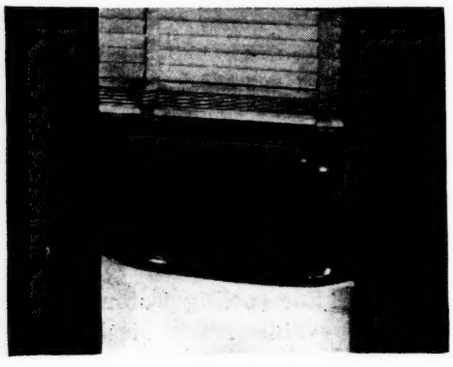
NAME—Swartwout attic louver.
PURPOSE—Ventilation of residence attics.
FEATURES—Louver is attached outside the house sheathing. Recommended sizes have outside dimensions of 15 x 18 in. and fit between



two standard 16 in. space studs. They fasten to the studs without special framing by nailing through the side flanges. Line of louvers is to include various sizes as well as various installation types either for old or new buildings.
MADE BY—*The Swartwout Co., Cleveland, Ohio.* 21

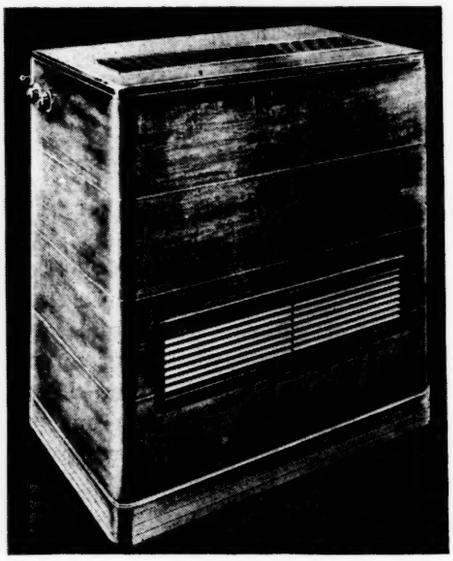
Room Air Conditioners

NAME—Carrier room coolers.
PURPOSE—Cooling and ventilating individual rooms in homes.



Master Model

FEATURES—Master model is designed for installations on window sills, uses Freon 12, and is powered by a ½-hp hermetically sealed compressor and a 1/20 hp fan motor. Conditioner measures 12⅜ in. high, 26½ in. wide, 26½ in. deep and projects 11 in. into the room. Ventilation is regulated by a damper. Unit has a 3-position switch, one to operate as an air conditioner and another as a ventilator. Replacement type air filters are provided. For use in larger rooms the Director air conditioner has been designed. This unit is a floor model using Freon 12 and is powered by a 1½ hp compressor and a 1/30 hp fan motor. Unit has automatic thermostat temperature control and a 3-position switch. It comes with

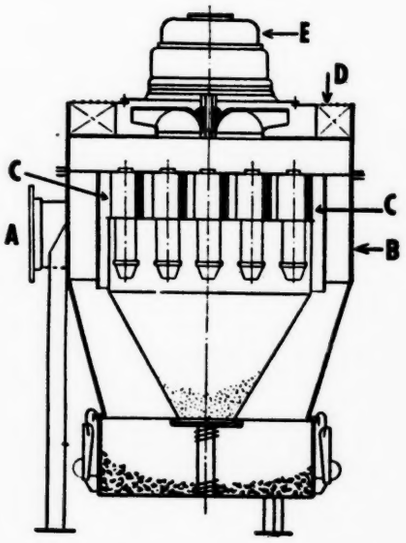


Director Model

a replacement type air filter. Unit measures 42½ in. high, 39 in. wide and 23 in. deep.
MADE BY—*Carrier Corp., Syracuse, N. Y.* 22

Dust Collector

NAME—Aerotec grinding dust collector.
PURPOSE — For the removal of all grinding-dust laden air.
FEATURES—Fan unit of high static pressure type overcomes resistance of the collector unit and develops a 2 in. w.g. air at the throat of a



closely coupled hood. Where extremely fine hazardous but non-explosive dust is encountered, an electrical secondary, operating from a standard lighting circuit may be added.
OPERATION—Dust laden air enters *A* and coarse material is precipitated in primary *B*. Partially-cleaned air enters annular space *C* into the tube secondary where fine dust is precipitated.
MADE BY — *Aerotec Co., White Plains, N. Y. Sales handled by Thermix Engineering Co., Greenwich, Conn.* 23

May, 1946

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below, circle the item number of the equipment in which you are interested, using the number found at the end of each item.

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Abstracts AND Reviews

PROPERTIES OF REFRIGERANTS

A comprehensive and factual manual on refrigerants for those concerned with air conditioning and refrigeration equipment has been prepared by the Air Conditioning and Refrigerating Machinery Association of Washington, D. C. It contains text, charts, and tables dealing with ammonia, methyl chloride, Freon 11, Freon 12 and Freon 22.

For each of the refrigerants there is information on recommended working pressures, condensing equipment, expected discharge temperatures, application, characteristics of oil mixtures, effects of moisture, suitable metals, and line sizes. Also included are temperature and pressure tables, properties of superheated vapor and a Mollier chart.

Properties of Commonly Used Refrigerants. Cardboard cover, spiral bound, 8½ x 11 in., 97 pages. Published by Air Conditioning and Refrigerating Machinery Association, Inc. Price, $1.

RADIANT HEATING

No subject is of greater interest in the heating field at the moment than radiant or panel heating. It is for that reason that the practical approach by Chase Brass & Copper Co., in their book is of particular value. It is not the intent of the book to have the published information supplant the services of an engineer but rather to give the heating field facts on the theory, broad principles and advantages of radiant heating.

It covers such topics as design procedure, panel heat transfer, panel system controls, friction loss in tube, expansion tank, choice of circulating pump, a sidewalk installation for melting snow, and construction of panels. A number of radiant heated homes and buildings are illustrated.

Chase Copper Tube for Radiant Heating. Paper bound, 5½ x 8½ in., 75 pages. Copy free by writing to Chase Brass & Copper Co., Waterbury 91, Conn.

INSTALLATION GUIDE

As a direct outgrowth of the research program in the I-B-R Research Home at the University of Illinois, a number of installation guides have developed. Guide No. 1 was published last year on the design of heating systems for small residences.

Guide No. 2—One Pipe Steam Heating Systems—covers buildings having a heat loss not exceeding 92,640 Btu per hour or equal to 386 sq ft of steam radiation. It has a number of simple illustrations to show recommended installation practice, tables of heat loss factors for various types of construction, equivalent square feet of radiation and other data. It presents a step by step method for determining the required radiation, selection of pipe size, and determining the size of the boiler. Guide has 16 pages.

Guide No. 3—One Pipe Forced Circulation Hot Water Heating Systems—covers buildings having a heat loss not exceeding 60,000 Btu per hour. This type heating system is intended to meet the budget requirements of small and medium size homes. Recommended installation practice is illustrated as well as typical boiler connections and suggested control arrangements. This 20-page guide also has heat loss factors for various types of construction, Btu requirements for various factors and other data, and a detailed method for calculating friction heads and radiator sizes based on temperature drop in system.

Guides published by The Institute of Boiler and Radiator Manufacturers, 60 East 42nd St., New York 17, N. Y. Paper cover, 8½ x 11 in. Price, 25 cents each.

FLUID FLOW

As a textbook for an elementary mechanics course in fluid motion, Hunter Rouse, Professor of Fluid Mechanics at State University of Iowa, has prepared Elementary Mechanics of Fluids. The subject is a complex one since it touches on many of the physical sciences—hydraulics, hydrodynamics and even thermodynamics.

While the text is not an over-simplification of the subject, the author has made an attempt to hold down the mathematics to that gained by a student in two years of college study. Each chapter ends with a number of problems. The book has been written with the thought of providing a good grounding in the basic principles of the subject.

Some of the chapters are Fluid Velocity and Acceleration; Pressure Variation in Accelerated Flow; Effects of Gravity on Fluid Motion; Effects of Viscosity on Fluid Motion; Form Resistance; Lift and Propulsion; Surface Tension.

Elementary Mechanics of Fluids, by Hunter Rouse. Cloth bound, 5¾ x 9 in., 376 pages. Published by John Wiley & Sons, Inc. Price, $4.

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HOUSING ABSTRACTS.—New monthly publication of Purdue Research Foundation, Lafayette, Ind. Yearly subscription, $1.75. Edited by Prof. F. W. Hutchinson.

CORROSION OF STEELS.—A 16-page booklet published by Carnegie-Illinois Steel Corp., and other subsidiaries of United States Steel Corporation, indicates how various commercial steels may reasonably be expected to resist the attack of atmospheric corrosion in particular. The summary, brought up to date by Dr. John Johnston, Director, Research Laboratory, United States Steel Corp., includes only information now generally accepted as reliable. Copies may be secured upon request to any Carnegie-Illinois Steel Corp. office.

NEWS OF THE MONTH

FACTORIES

Albert Kahn head evaluates mechanical and natural ventilation in industrial buildings.

"Should the industrial plant be of monitor type to provide the maximum of daylight throughout the plant, or should it be of the flat roof type with controlled ventilation and controlled lighting?" This was the question posed by George H. Miehls, new president of Albert Kahn Associated Architects & Engineers, Inc., in a talk on The Industrial Plant of the Future before the Rochester (N. Y.) Society of Architects and the superintendents and production managers group of the Industrial Management Council on April 1.

Mr. Miehls' answer to this particular question was: "This question has been a source of controversy in many quarters. In this connection, I feel somewhat like Mark Twain, who, when he was asked to give his views on the merits of heaven or hell, answered that he did not care to be drawn into that controversy because he had so many friends in both places. Previous to the war we constructed many facilities for manufacture. In a vast majority of these facilities, we utilized natural daylight and natural ventilation to the greatest possible degree. From the standpoint of economy of operation and employee comfort they were efficiently planned and have given many years of service. Many owners still prefer that type of industrial plant. But then came the war, and the hysteria attendent upon the possibility of bombing by enemy action. Blackout became the rule, and with it came the necessity of providing artificial ventilation and continuous artificial lighting. As a substitute for the central system of ventilation with its complete duct distribution system, we worked in conjunction with certain manufacturers to provide the less costly individual supply and exhaust units in the roof to provide for the necessary air movement inside the factory building.

G. H. Miehls

"There came the development of the fluorescent light which produced a higher light level at working height at less expenditure in operating current and far less heat generation than the incandescent lights previously used. Today we are building both types of manufacturing facility—both monitor type and the type without monitors. What are the factors which determine the final decision? You can assist the owner in making the choice after an evaluation is made of the following factors:

(1) The monitor type building permits of greater air movement than the building with mechanical ventilation, but this air movement fluctuates with the velocity and direction of the wind;

(2) There is greater cost involved in mechanical ventilation than there is in natural ventilation through monitors, but mechanical ventilation will provide superior control;

(3) The lighting system must be installed to permit operations for more than the daylight shift, and even with monitors, you will usually find that the lights are burning all day; the reason for this is the fact that in many industries workmen now demand a higher constant light level than daylighting can provide. The result is that in these instances the greater capital cost of monitor type construction cannot be amortized by the saving in lighting current costs;

(4) Are there processes inside the building which produce a serious condition as to heat, or smoke or vapor, which makes exhaust of a great amount of air inside the building mandatory, thus making it difficult to maintain a balance between the supply and the exhaust; and

(5) The heating system for a building without monitors will normally require less capital outlay than the building with monitors, and the operating cost is likewise lower.

As a result of our investigations—and except for buildings which are used for forging operations, or foundries, where monitors are practically mandatory—we have found that the initial capital costs of buildings without monitors are less than those with monitors; that operating costs of mechanical ventilation are higher for buildings without monitors than for those with monitors; that heating costs are higher for buildings with monitors than for those without monitors; that lighting costs for the initial installation are the same for both types. Therefore, in general, except for the psychological advantage that the monitor type building may provide, the trend is toward the artificially lighted, artificially ventilated plant, with sash in the side walls where the worker can see what the weather is out of doors, and which minimizes the atmosphere of confinement. . . ."

LARGE BUILDINGS

Housing program is not exclusively for single dwellings according to authorities.

Under the pressure of the national housing shortage to which have been directed the energies and attentions of practically all government and private building agencies, residential housing on a large scale is assuming the proportions of one of the nation's heavier industries.

• **RENTALS.**—All attention is by no means directed toward single private residential units. In fact, Wilson

Wyatt has acknowledged the probability that most veterans will require rental units.

In order to clear up misunderstandings regarding the true importance that multiple dwellings will play in the program, Thomas S. Holden, president of F. W. Dodge, directed an inquiry to Mr. Wyatt concerning the confusion among architects, general contractors and building trades who might be employed on multiple dwellings but not extensively on small house building. Mr. Wyatt's reply was as follows:

"One of the vital requirements of the veterans' Emergency Housing Program is housing for rent because countless veterans will not want to buy or be in a position to do so. Therefore, multiple dwellings are a most important part of the program and we hope that the industry will do its utmost to produce them. I know that you understand that they must be produced under our program at a price veterans can afford or the whole objective of the program is lost. However, I want to assure you that priorities are issued for the sole purpose of producing homes for veterans and that multiple dwellings have a definite and highly important part in the program".

Another statement by Mr. Wyatt reveals that expansion of title VI of the National Housing Act as contained in the new version of the Patman Bill would virtually insure private builders against a loss in the construction of large rental housing units. More than $1 billion in insurance authorizations would be allotted (with another billion dollars made available at the discretion of the President) to grant 90% loans based on current costs rather than normal values.

• **HOSPITALS.**—A total of 26 major and minor hospitals for Veterans Administration were under construction at the end of February. Plans and specifications were completed for four other projects and specific sites were selected and approved for another 22 hospitals. Still another program calling for 39 additional projects is pending before Congress for approval of funds totaling $140 million.

• **COMMERCIAL.**—Bureau of Labor Statistics figures indicate that at the peak of the housing program in 1947 almost twice as many workers will be needed for non-residential construction as are now employed in that type of building. In other words, according to the interpretations of NHA, there will be more, not less, employment, building, and investment in the heavy-construction, non-residential fields. Mr. Wyatt, again, emphasizes that fears regarding stoppage of heavy construction during the housing emergency are unfounded and based on a misunderstanding of the order and of the building program.

• **CONTRACTS.**—A forward step in the technique of public housing contract bidding was taken in New York State during April when, over the protests of Mayor O'Dwyer, Park Commissioner Moses and the New York City Housing Authority, Governer Dewey approved a bill requiring the specification of public housing contracts into at least four parts with separate bids and awards on each.

Under terms of the bill, public housing authorities are required to have separate specifications and bids for (1) plumbing and gas-fitting; (2) steam-heating, hot-water heating, ventilating and air-conditioning installations; (3) electric wiring and standard illuminating fixtures. These three contracts would be in addition to the master contract covering general construction.

"There is much controversy concerning the measure," Governor Dewey said in a memorandum. "Certain of the housing authorities and other administrative agencies urge disapproval of the measure on the ground that it involves the agencies in complications in the handling of details with contractors who, ordinarily, would be sub-contractors handled by the general contractor.

"The issue seems rather simple. Unquestionably the handling of more rather than fewer contracts increases administrative problems. On the other hand, I am satisfied that under the provisions of this bill, the construction can be accomplished more cheaply. The State itself is required to let contracts with separate specifications under Section 125 of the State Finance Law. In fact, the provisions of this bill are drawn almost word for word, with one exception, from the provisions of that section.

"If the State can handle the administration of such separate contracts for all its work, it would seem that its subdivisions can do the same when it is definitely in the public interest."

• **PRE-FAB.**—No small part of the industrial aspects of the housing emergency are reflected in unprecedented stimulation of interest in prefabrication. From the manufacture of smaller units to be built into specified house designs to the complete packaged home, prefabrication is taking an increasingly important place among the nation's industries.

One new corporation, knows as Shelter Industries, Inc., was announced by Donald Deskey, industrial designer, Mr. Deskey's houses are to be factory fabricated, completely equipped homes, ranging in erected prices from $5 to $6 thousand. These houses are the first factory fabricated houses which will incorporate a new central utility unit (H&V:2:46:p.94) which is being manufactured by the Ingersoll Steel Division of the Borg-Warner Corporation.

One spectacular result of industrial interest in prefabrication has been the machine which constructs a concrete house in 24 hours. Called a Tournmalayer and built by Le Tourneau, this machine looks like a gigantic tractor and moves onto a house site on 12-ft wheels carrying forms for walls of the house. The walls are poured and allowed to set and the machine then picks up its forms and moves on.

Reynolds Metals may produce an aluminum house and has erected an experimental model in its factory at Louisville. The Reynolds house, painted aluminum siding and conventional design, looks just like an ordinary frame cottage.

Henry Kaiser expects to build 10,000 California houses this year. The Kaiser house incorporates a number of prefabricated elements but does not call itself prefabricated. Another project which shies away from the term "prefabricated" is the Johnson

Construction company's Village of Vision on display at John Wanamaker's in New York and Philadelphia. These houses are exterior shells and floor plans constructed on the site of various prefabricated elements, but do not include interior finishing, fixtures, heating facilities, lighting, etc.

A complete revision of ceiling prices for prefabricated homes made mostly of wood, announced by the OPA, permits calculation of prices on the basis of current material and labor costs plus mark-ups of 36% at the manufacturer's level and 10% at the reseller's level.

• **CODE.**—On April 20, the Building Officials Conference of America, Inc., announced publication of a basic building regulations code covering the erection of dwellings and other classes of construction and prefabrication techniques. The provisions of the Code covering the materials and methods of construction of prefabricated buildings are intended to permit the use of all materials or methods of construction which meet minimum strength, durability and fire resistance and requirements including among others, the use of steel, aluminum, magnesium, masonry, asbestos, plastics, etc., or any combination of such materials.

POWER

Preliminary tests under way for coal-fired gas turbine. Navy tests oil-fired units. Army flies turbine planes.

Seventeen projects at six institutions are now under way to develop the apparatus necessary for operating a locomotive combustion turbine on coal, according to J. I. Yellott, director of research, BCR Locomotive Development Committee. An entire succession of bins, feeders, pulverizers, burners, controls and ash separators must be designed and perfected. A controllable supply of relatively clean gas at 1300°F and 60 lb per sq in. pressure must be produced for the turbine in a reliable, compact apparatus.

• **SIX LABORATORIES.**—The Johns Hopkins University, Baltimore, has built a full-scale model of the coal bunker and a screw feeder, and a coal dryer for delivering dry coal to a crusher (b). Johns Hopkins is also developing the coal feeder (d), the recirculation control (e), the swinging gate meter, and is testing the spiral combustor, and "coal atomizer."

Battelle Memorial Institute, Columbus, Ohio, is concerned with a fundamental study of burning pulverized coal rapidly under pressure, including tests in a "vortex" combustion chamber.

The Institute of Gas Technology, Chicago, has developed the flash pulverizer for "exploding" crushed coal to minus 200 mesh while passing through a nozzle with steam. The removal of fly ash from hot gases by small cyclone-type separators and the feeding of coal against pressure are also being investigated there. Most of the fly ash can readily be removed from the combustion gases before they enter the turbine blading, tests have shown.

Purdue University is studying the effect of sulphur on stainless steel at high temperatures. Purdue is also testing fly ash for use in rail sanding.

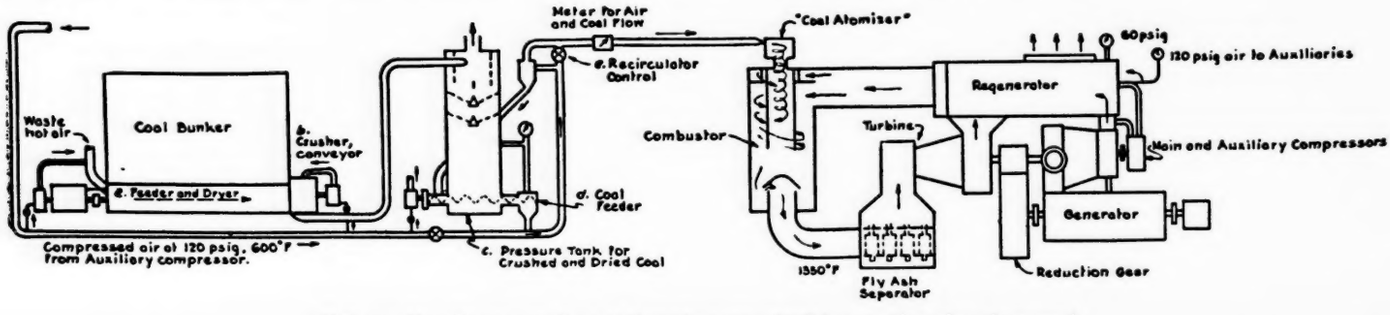
The Southern Research Institute, Birmingham, is building an instrument for measuring the amount of coal in the pressure tank (c) and for determining the rate of coal feed.

When the various elements of the equipment have been developed they are to be assembled and given full-scale combustion tests at the Alco Products Division, American Locomotive Company, Dunkirk, N. Y.

• **NAVY.**—Successful operation at a gas temperature of 1350F has been accomplished in a series of successively increasing temperature tests on an Allis-Chalmers experimental gas turbine plant installed in the U. S. Naval Engineering Experiment Station at Annapolis. Designed and built by Allis-Chalmers for eventual operation with hot gas at a temperature of 1500 F, the 3500 hp unit is the first large multi-stage gas turbine for continuous power generation at high efficiency ever operated successfully at such high temperature.

Although this highly significant gas turbine has been developed as a Navy project, its basic elements have characteristics suitable for both land and marine practice, according to Allis-Chalmers engineers. In carrying out the development in cooperation with the Navy, the company is utilizing its wide experience in gas turbine practice, as already successfully applied to Houdry catalytic cracking, aircraft supercharging and jet propulsion.

• **PROBLEMS.**—Numerous mechanical, metallurgical and fluid flow problems so prominent in gas turbine development have already been overcome and much has been determined about operating characteristics of the turbine and compressor in completed stages of the comprehensive test program.



Schematic diagram of coal burning gas turbine under development

The multi-stage turbines in this installation are designed for high efficiency. The Annapolis unit embodies innovations in cooling methods, permitting the multi-stage turbines to operate safely at high inlet temperature by avoiding the undue weakening effect of the high temperature on the materials used for the rotating parts.

The gas turbine plant is arranged with two turbines operating in parallel, one turbine supplying the power required to drive the compressor, the second turbine furnishing the power necessary to satisfy the requirements of the driven machine or dynamometer. The compressor unit operates at a speed commensurate with the lowest possible fuel consumption. Air enters the compressor at 40,000 cfm and is discharged at a pressure of 45 lb per sq in. to the heat exchanger where it picks up heat from the turbine exhaust gases. The heated air then passes through two separately oil fired combustion chambers where it is further heated to the desired turbine inlet temperatures. The gases then expand in two multi-stage turbines, one of which supplies the power to drive the compressor, the other furnishing external shaft power.

Careful to point out the experimental nature of the Annapolis gas turbine, Allis-Chalmers nevertheless indicates in its references to this major development project that it foresees a promising future for gas turbines, particularly in railroad locomotives, aircraft propulsion units, marine and electric power generation prime movers, and large refrigeration and air conditioning compressors.

• **PLANE.**—The Consolidated Vultee XP-81, built for the United States Army, first plane to fly with a gas turbine designed for propeller drive, and said to be the most powerful fighting plane in the world, has a "Propjet" type of engine that pressurizes the cabin as well as flying the plane at great speed on long flights. Air blows from the axial compressor of the Propjet to do this job, and at high altitudes also heats the air that flows into the cabin. The Propjet engine is in addition to a super 1-40 G-E jet engine, and the two together can produce as much power as all four reciprocating engines on a B-29 superfortress, driving the bullet-like fighter at more than 500 miles an hour. For cruising only the Propjet is used, with both engines used on take-offs, neither requiring a warm-up.

The propeller drive gas turbine fits flush in the tapering nose, while air rams in a duct rims the nose of the plane and into the axial flow compressor, which is directly behind the reduction gears forward. The compressed air is whipped to combustion chambers. There fuel burns intensely, raising the temperature and velocity of the air and gases, which then, with great energy, exert pressure on blades of the turbine wheel. The turbine, spinning more than 10,000 times a minute at a temperature of more than 1500 F, absorbs the major part of the energy in the gases. Both engines usually burn kerosene.

The Propjet engine was designed and developed for the Army Technical Service Command of the Army Air Forces at the Schenectady works of the General Electric Co. The 1-40 jet engine was developed for the ATSC at the River Works of General Electric at Lynn, Mass.

AIR CONDITIONING

Some recent notes on the field of air conditioning and refrigeration.

Following are a few miscellaneous paragraphs bearing on various events and trends in the field of air conditioning and refrigeration.

• **GERMANY.**—According to a recent Westinghouse release, the German air conditioning and refrigeration industry is from five to ten years short of American standards in the field. This statement is based on a three months survey of German industrial plants. The report of German industries was prepared for the United States Army's Technical Industrial Intelligency Committee by Gunnar Berg, air conditioning and refrigeration man for Westinghouse. The Germans, Mr. Berg reported, had not progressed past the experimental stage in the air conditioning of railway cars and seldom used air conditioning in their factories even in the underground plants which were used during heavy bombing.

• **EDUCATION.**—The York Institute of Refrigeration and Air Conditioning graduated its first class on April 5. This class consisted of 30 commercial field servicemen who had completed a six-week course in servicing of commercial equipment.

• **INSTRUMENT.**—A new electronic instrument known as a dewpoint recorder has been developed by the General Electric Company. This new instrument can determine automatically the amount of moisture in a gas, and is adaptable to many diverse uses. Practically any field where control of moisture is essential can put the recorder to use.

Able to measure in terms of absolute humidity even the amount of moisture in the air of an office or home, a home or commercial refrigerator, an air conditioning system or a cold storage plant, the dewpoint recorder is an electric combination of heater, refrigerator, mirror and gas chamber. As the gas chamber feeds a test gas out over a stainless steel mirror, the refrigerator and heater cool or heat the mirror until a temperature is attained at which moisture in the gas precipitates into dew on the mirror. Keeping its own "eye" on the mirror, the device spots the dew the instant it forms, and then simultaneously records this dewpoint temperature on a graph or chart. Working in co-ordination, the refrigerator and heater hold this dewpoint temperature within a tolerance of two degrees, so that a continuous reading is obtained.

In design for new refrigerating equipment the dewpoint recorder would inform engineers whether control equipment was adequately regulating moisture content in the various compartments.

In air conditioning systems the recorder would

signal to the plant engineer when relative humidity became too high in the air flow to the conditioned space, and he could then regulate his machinery to bring the humidity down to its proper comfort point, or, in the case of industrial systems, to the point where the relative humidity would be in correct amount.

• **LINERS.**—Three new 18,000-ton Delta Line passenger liners under construction at Pascagoula, Miss., will be air-conditioned by Carrier Corporation of Syracuse, N. Y. Orders placed with Carrier call for equipment to cool all passenger staterooms, public salons, officer's deck, promenade deck, hospital space, mess rooms and crews quarters. The new vessels, slated for the New Orleans-Central America run, will operate almost entirely in tropic temperatures. Other recent orders received by Carrier include air conditioning equipment for nine vessels of the Grace Line and two United States Maritime Commission ships under construction at the Bethlehem-Alameda Shipyard, Alameda, Calif.

• **SEED.**—India's old famine-producing problem, the loss of seed between crops because of the country's destroying heat and humidity, is on the way to being solved by shipment of refrigeration equipment under U. S. priority to three Indian cities to set up cold storage warehouses to save the 2,956,800 pounds of seed potatoes lost annually because of climatic conditions. The shipment is the first step of a long-range program backed by India's Department of Education, Health and Lands and ties in with the overall, world design to thwart starvation.

The equipment will be installed in four seed potato storage warehouses in the northern Indian cities of Lahore, Delhi and Gurdaspur by Volkart Bros., Carrier distributors, whose engineers designed the systems. The warehouses, each with a capacity of 660 tons of seed potatoes, will be privately operated and financed, with the Indian Government assisting in an advisory capacity only. The Department of Education, Health and Lands has estimated the refrigerated plants will have the further advantage in reducing the cost of seed potatoes to Indian farmers from approximately 25 Rupees to 15 Rupees per maund (82.28 lbs), despite the higher initial investment and cost of operation. The saving is made possible by the reduction of spoilage from a present average of 50% without refrigeration to a negligible amount with it.

• **ICEBERG.**—One of the most fantastic secrets of the war was uncovered when the Combined Chiefs of Staff revealed that the British, American and Canadian Governments had experimented during 1942 and 1943 with the idea of building a 2,000,000-ton carrier out of iceblocks to combat the U-boat menace according to "The New York Times."

"The proposed iceberg carrier, labeled the 'Habbakuk project'," the announcement said, "was considered so important it was the subject of detailed discussion at the Quebec Conference in 1943 as an antidote to German submarine warfare and an instrument to provide air cover for the future invasion of Europe."

The "S. S. Habbakuk" was to be 2,000 ft long, 300 ft wide—comparable dimensions of our Midway class super-carriers, the largest in the world, are 968 by 113 ft—and 200 ft deep. The estimated cost of these 2,000,000 tons of reinforced ice would have been approximately $70 million. It was going to get about at a speed of "a few knots" by means of "a large number of electric engines, attached as nacelles" to an outer insulated skin.

OHI

Oil heat industry faces problems.

With more than 2.5 million oil heating installations in American homes today, the oil heat industry through its association, Oil Heat Institute of America, gave consideration to its problems and developments at the 23rd annual convention held at the Benjamin Franklin Hotel, Philadelphia, Pa., April 22-27. Record-breaking attendance was reported at the exposition held concurrently at the Commercial Museum.

• **FIGURES.**—According to W. A. Matheson, president of the institute, counting new equipment sales, service, and fuel oil sales, oil heating will soon become a half-billion-dollar a year business.

Group of registrants listens to President Matheson

At the end of 1935 there were 1,152,125 domestic conversion oil burners and units in use; in 1945, 2,525,655 units. Commercial oil burners jumped from 176,240 in 1935 to 345,090 in 1945.

• **PRODUCTS.**—Represented at the exposition were 50 oil burner manufacturers, 62 oil burner accessory manufacturers, 3 oil companies, and 12 other exhibitors. Products ranged from controls and burners to the oil fired steam generator for industry.

Latest in the pot type burner field is a development of the Socony-Vacuum Technical Service Laboratories, Brooklyn, N. Y., just announced, which is termed a modified domestic fuel oil burner and is expected to be in production for the 1947 heating season. Unit can burn No. 2 catalytic fuel oil.

• **CATALYTIC CRACKED OIL.**—At the engineering session held on Friday afternoon, three papers were presented on aspects of catalytic cracked oil. The

general discussion brought out some outstanding facts.

1. It is time to give some thought to competing fuels. It is necessary to have better oil so that five years from now when new natural gas lines are completed, industry will be ready to face this competition.

2. Aside from the heating market, there is a fast growing demand for oil from other fields, and the end is not in sight. Streamliner locomotives and other diesel units constitute one factor. Gas turbines and jet propulsion are not to be neglected in considering demands of industry for fuel.

3. Industry must do some research. While it is important for the oil refineries to produce a standard fuel, industry is faced with problems that can only be answered through research. In many cases, manufacturers will have to start from scratch in finding solutions.

4. Competition with gas will make reliable burning essential. Manufacturers believe it is the oil man, rather than the burner manufacturer who must be blamed for the poor burning of oil, when oil trouble does develop.

5. At present there are over 2,000,000 vaporizing pot burners in use. While some question exists about these burners being able to use "cat" oil, the oil companies feel optimistic about the ability of such units to burn the new fuel.

• **PAPERS.**—Aside from panel discussions, papers presented include:

Effect of Catalytic Cracking on Fuel Oil Supply, by Arthur E. Pew, Jr., Vice-President in Charge of manufacturing, Dr. J. R. Bates, assistant to Mr. Pew, and Dr. J. B. Hill, Manager of the Development Division, all of the Sun Oil Co.

Properties of Catalytic Fuel Oil Distillates and Their Combustion in Present and New Types of Burners, by W. A. Sullivan, Shell Oil Co.

The Program of the American Society for Testing Materials for the Improvement and Standardization of Fuel Oils, by Milton A. Powers, Chief Engineer, Timken Silent Automatic Division of the Timken-Detroit Axle Co.

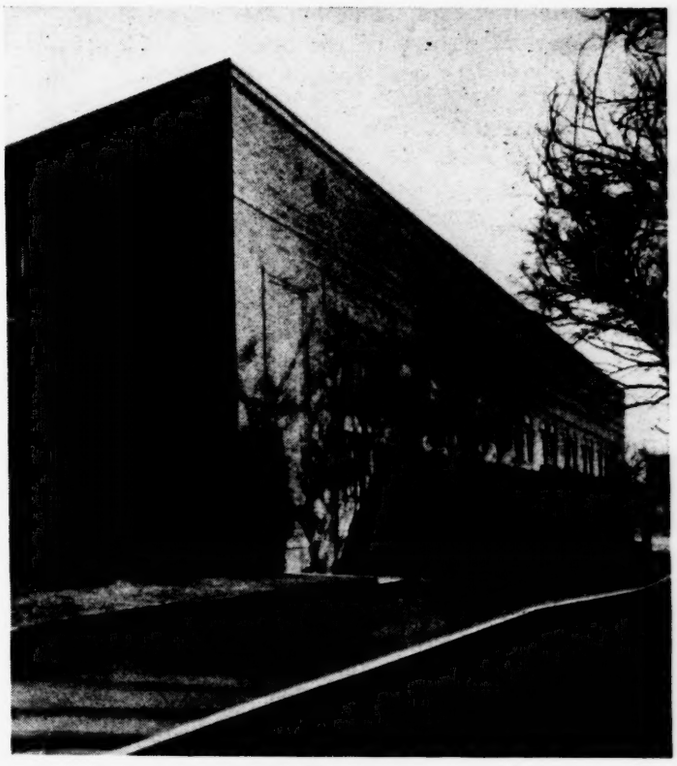
ORGANIZATIONS

Professional and business groups take up the challenge of peace.

That peacetime economy is in many ways as challenging as war is evidenced by increased activities of business and professional organizations serving the heating, ventilating and associated industries.

• **ASHVE.** — The American Society of Heating and Ventilating Engineers has purchased the property at 7218 Euclid Ave., Cleveland 3, Ohio, to provide adequate research facilities for serving the heating, ventilating and air conditioning industry as well as associated industries. The move to the new home for the society's research laboratory was effective April 1.

The property consists of a substantial dwelling with a large, two-story, brick, auditorium-type building attached. It is located on one of Cleveland's main traffic arteries. The brick building, which is 58 ft x 125 ft on its foundation houses the laboratory proper. At grade level are three large rooms with 11 ft ceilings



New ASHVE Laboratory

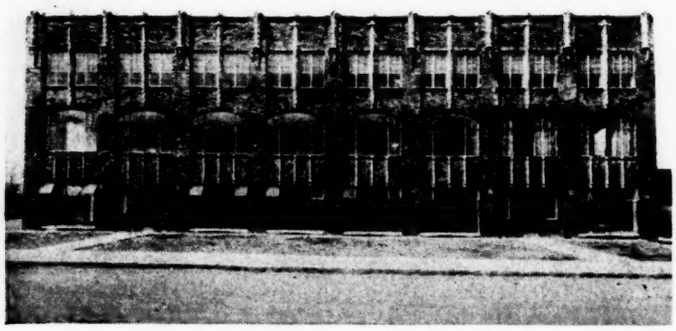
and numerous small service rooms totaling about 5300 sq ft which provide excellent research, workshop and storage facilities. The only basement space is that provided for the heating plant. The second floor of the laboratory provides 4600 sq ft of floor space completely free of any obstruction with 18 ft head room.

• **PSYCHROMETRY.**—At its next meeting the International Joint Committee on Psychrometric Data will concern itself with the thermo dynamic properties of moist air in accordance with an agenda prepared by a sub-committee consisting of John A. Goff, Dean, Towne Scientific School, University of Pennsylvania; Dr. C. S. Cragoe, Chief, Heat Measurements Section, National Bureau of Standards; S. Gratch, Instructor in Mechanical Engineering, Towne Scientific School, University of Pennsylvania; Dr. L. P. Harrison, Chief, Technical Investigations Section, U. S. Weather Bureau, and Dr. F. G. Keyes, Professor Chemistry, Massachusetts Institute of Technology.

The following organizations are participating: Canada — Department of Transport, Meteorological Division; National Research Council; Great Britain—Institution of Heating & Ventilating Engineers; National Physical Laboratory; The Physical Society; United States—American Institute of Chemical Engineers; American Physical Society; American Society of Heating & Ventilating Engineers; American Society of Mechanical Engineers; American Society of Refrigerating Engineers; Department of Commerce

—National Bureau of Standards, Weather Bureau; War Department—Signal Corp.

• **ANTHRACITE.** — The Martz Building at Melrose Ave. and Old River Road, Wilkes-Barre, Pa. was purchased as a new headquarters and laboratory building for Anthracite Institute. The building, erected in 1926 for offices and garage of the Martz Bus Lines, is of steel and concrete construction with a brick veneer facing. It is built in two parts, a three-story front section approximately 105 x 36 ft in area, and a two-story back section about 108 x 156 ft.



New Anthracite Industries Laboratory

The building is located on Old River Road, just one-and-a-half miles from the business center of the city. A railroad siding is available for the delivery of heavy equipment and materials. Anthracite Institute will use the front section for its main offices, and the back section for laboratory and research facilities. As the back building has over twice the floor space of that now available at the Institute's present laboratory in Primos, Pa., all present laboratory activities can be consolidated in one building with room for a more advantageous grouping of research and development work and for future expansion.

• **BCR** —Effective May 1, the administrative offices of Bituminous Coal Research, Inc., national research agency of the bituminous coal industry, are moved from 719 Oliver Building to 912 Oliver Building, Pittsburgh 22, Pa.

BCR will have a research budget of $401,000 which will finance various projects under the direction of Dr. Harold J. Rose, director of research. Work is done cooperatively at existing laboratories. In addition to research for the Locomotive Development Committee, BCR has in progress studies of residential group heating, automatic equipment and smokeless hand fired equipment. A report is being prepared which will summarize the study of residential group heating and will provide a basis for estimating costs of residential group heating with coal under various conditions.

• **WARM AIR.**—The National Warm Air Heating and Air Conditioning Association announces the beginning of its dealer training program covering design, installation and operation of warm air gravity and warm air-winter air conditioning systems. Based on present estimates, 30, two-day, application engineering conferences will be held this year in as many trading areas throughout the country with an estimated average attendance at each conference of 75 warm air dealers and their employees, or a grand total for 1946 of 2,250 students. For 1947 it is estimated 70 conferences will yield a total attendance of 5,250, making a combined attendance for 1946 and 1947 of 7,500 students.

Guy A. Voorhees has joined the NWAHACA to direct its dealer training program. Mr. Voorhees' title will be that of Application Engineering Director. More than thirty-five years of practical warm air heating experience, including shop and installation, is Mr. Voorhees' background, during which period he has been a heating contractor, an engineer, manufacturers' representative, and sales manager. He is registered in the State of Indiana as a professional engineer and is a member of the American Society of Mechanical Engineers, American Society of Heating and Ventilating Engineers, the National Society of Professional Engineers, and the National Federation of Sales Executives.

• **ASRE.**—The American Society of Refrigerating Engineers will hold its Spring Meeting in the Twin Cities, Minneapolis-St. Paul, with headquarters at the St. Paul Hotel. The date of the meeting is June 2, 3, 4 and 5. The Twin Cities Section of the A.S.R.E. will be the host of the convention and is arranging for a full program of technical sessions and entertainment, including sightseeing trips and fishing in the famous Minnesota lakes.

The program of the technical sessions includes the following papers:

"A New Psychrometric Chart"—E. P. Palmatier and D. D. Wile, Carrier Corp., Syracuse, N. Y.

"Heat Flow Through a Complex Wall Structure"—C. F. Kayan, Columbia University, New York.

"Microbial Controls in the Refrigerated Warehouse"—W. L. Mallmann, Michigan State College, Lansing, Michigan.

"Application Practices Necessary for a 'Quality Job' "—Ty Fenn, C. S. Leopold, Philadelphia, Pa.

"The Role of Consulting Engineers in Upholding Standards"—Sam Lewis, E. P. Heckel and Associates, Chicago, Ill.

"The Role of the Air Conditioning Contractor in Upholding Standards"—A C. Buensod, Buensod-Stacey Corp., New York, N. Y.

"Designing Air Conditioning Systems for Low Maintenance"—M. G. Kershaw, E. I. duPont de Nemours and Co., Wilmington, Del.

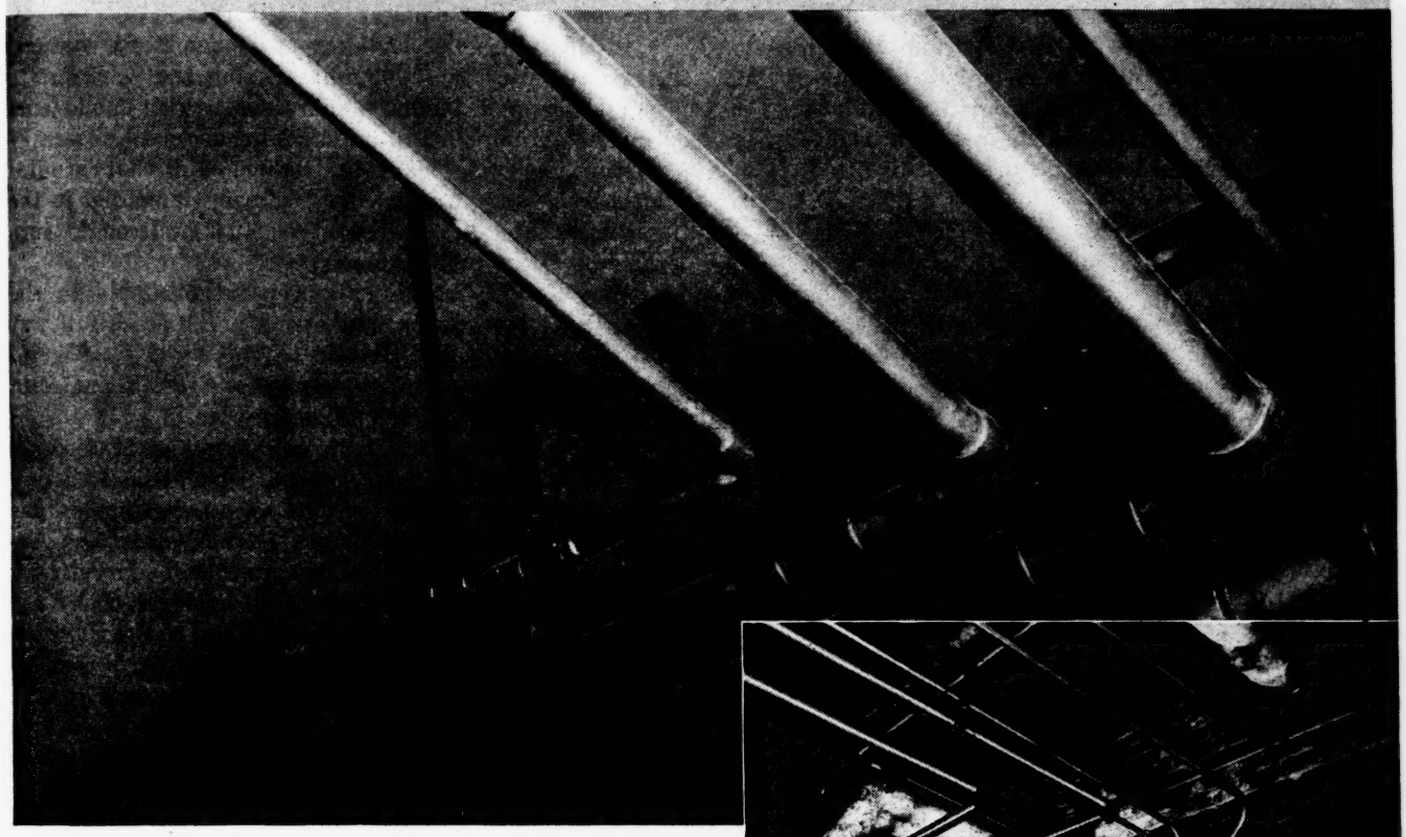
"Air Conditioning of Small Commercial Establishments"—Wm. Piene, Carrier Corp., Syracuse.

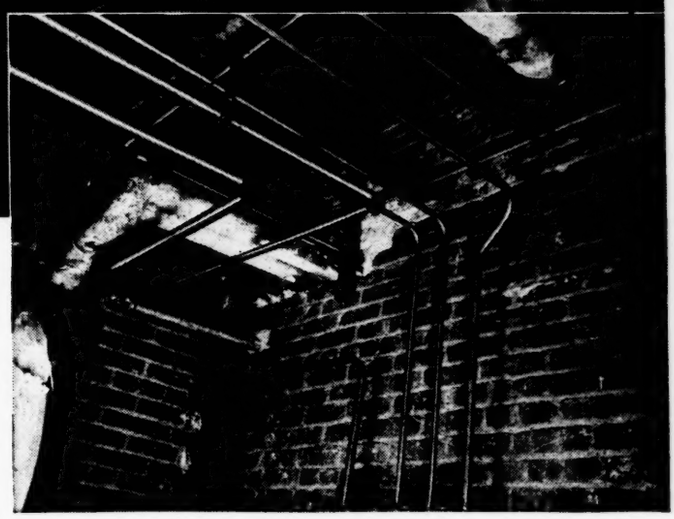
"Air Conditioning of Office Buildings, Hospitals, Hotels and Apartments"—George W. Meek, Syracuse, N. Y.

"Design of Large Spaces and Industrial Installations"—Fred Wood, York Corp., York, Pa.

"Technical Phases of Home Freezer Development"—C. E. Lund, Seeger-Sunbeam Corp., St. Paul.

NO JOB IS TOO SMALL...OR TOO LARGE... FOR COPPER





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"Rating and Testing Cooling Coils"—C. M. Ashley, Carrier Corp., Syracuse, N. Y.

"Conductivity of Various Materials at Low Temperatures" — G. B. Wilkes, Mass. Inst. of Technology, Cambridge, Mass.

• **REMA.**—For the first time in nearly six years, the mechanical refrigeration and air conditioning industry will hold a complete showing of its new products —ranging in usefulness from 80 degrees above zero to 150 degrees below—in the Cleveland Public Auditorium October 29 to November 1, according to announcement of plans for the Fourth All-Industry Refrigeration and Air Conditioning Exposition by a show committee headed by K. B. Thorndike, a director

K. B. Thorndike (left) and H. F. Spoehrer

of the Refrigeration Equipment Manufacturers Association. The show is under the sponsorship of REMA with the cooperation of the Frozen Food Locker Manufacturers and Suppliers Association, the two groups having nearly 250 members engaged in the manufacture of all types of refrigeration and air conditioning equipment. Closely associated with the latter group is the National Frozen Food Locker Association, representing operators of locker plants, the total number of which now approaches 7,000.

These three associations will hold meetings in Cleveland at the time of the exposition, and word has been received by Mr. Thorndike's committee that three other industry organizations also will convene in Cleveland the week of October 28. They are the Refrigeration Equipment Wholesalers Association, the Refrigeration Service Engineers Society, and the recently formed National Association of Refrigeration Contractors.

GAS

Western gas companies invest heavily to boost supplies of natural gas.

• **PIPE LINES.** — With natural gas serving as the principal fuel for house heating in Southern California, the gas industry is investing in excess of 45 million dollars for pipelines and auxiliary facilities to supplement available supplies of natural gas.

These figures were cited in a talk before a meeting of the American Electro-Platers Society at Los Angeles by Roy M. Bauer, gas supply supervisor of the Southern California Gas Co. and Southern Counties Gas Co., both of Los Angeles, in which he discussed the natural gas industry of California.

• **DEMAND.** — Declaring that demands for natural gas already exceeded supplies during the war, due to population and industry increases, which made curtailment of supplies to industrial consumers necessary during peak periods, Mr. Bauer said that studies of the postwar situation have already indicated to the gas companies that natural gas must be brought into the state from other states.

Steps already taken to increase the supply in the Los Angeles area were cited by Mr. Bauer as follows:

Construction completed on a $4,000,000 pipeline to bring natural gas to Los Angeles from the Goleta Field, 110 miles north of Los Angeles.

Construction to start in mid-summer 1946 on a $15,000,000 pipeline to be built by Pacific Lighting Corp., parent company of the two Los Angeles gas firms, from Santa Fe Springs oil field near Los Angeles to the Colorado River, where it will connect with a 700 mile, $25,400,000 line being constructed by the El Paso Natural Gas Co., El Paso, Tex., to the Permian Basin dry gas field in the Texas Panhandle.

Connecting lines required to link the end of the Santa Fe Springs-Colorado River line with the gas companies' facilities in Los Angeles are estimated to cost an additional several million dollars.

The Texas-California line will have a capacity for ultimately delivering 305,000,000 cubic feet of gas to Los Angeles from the Panhandle area, Mr. Bauer declared. The Goleta line, already in operation is designed to carry 165,000,000 cubic feet of gas per day.

• **SOURCES.** — As the year began, Mr. Bauer stated, Southern California was continuing to receive about 95% of its gas from oil wells and underground storage reservoirs. Typical of such reservoirs, he said, were the one in the old Playa del Rey oil field near Los Angeles, and the Goleta dry gas field, into which gas is pumped during slack summer seasons and held available for withdrawal when the demand rises.

Indicative of the demand on the gas companies, Mr. Bauer said that in excess of 83% of California's 8,800,000 population use natural gas as a primary fuel. Active meters, he reported, at the end of 1945 totaled 2,150,000 in the domestic and commercial category, and 5,500 in the industrial classification.

The gas supply available to the two Los Angeles utilities, according to the speaker, was fairly constant during the war period, subsequent to the middle of 1942, in spite of the increased production of crude oil. Following the end of hostilities, however, crude oil production dropped and the net gas available to the gas companies declined correspondingly.

(News Section concluded on page 120)

Because they're dependable

There's a Bethlehem Galvanized Steel Sheet for that forming job or ductwork installation—a sheet that you can rely on for ductility, for ease in working, for uniformity in gage, size and flatness. For there's one thing about Bethlehem Sheets—they're dependable, all the way along the line.

BETHLEHEM STEEL SHEETS

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Degree-Days for March, 1946

HEATING AND VENTILATING'S 19TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

CITY	MARCH			CUMULATIVE, SEPTEMBER 1 TO MARCH 31			HEATING SEASON[1]
	1946	1945	NORMAL	1945-46	1944-45	NORMAL	NORMAL
Abilene, Texas	192	169	273	2334	2292	2034	2061
Albany, New York	661	664	980	5858	5996	5848	6580
Albuquerque, New Mexico	532	618	527	4041	3883	3970	4298
Alpena, Michigan	810	816	1213	6414	6455	6873	8299*
Anaconda, Montana	903	1091	1081	6338	6467	6737	8357**
Asheville, North Carolina	342	269	555	3600	3366	3831	4232
Atlanta, Georgia	183	162	388	2654	2632	2758	2890
Atlantic City, New Jersey	549	489	806	3964	4188	4437	5176
Augusta, Georgia	128	84	273	2023	2020	2137	2161
Baker, Oregon	797	884	880	5823	5531	5904	7163
Baltimore, Maryland	377	339	701	3653	3870	4163	4533
Billings, Montana	711	848	955	5610	5700	6209	7119
Binghamton, New York	603	597	995	5426	5788	5960	6808
Birmingham, Alabama	186	162	260	2552	2447	2283	2352
Bismarck, North Dakota	848	959	1283	7842	7182	8152	9192
Block Island, Rhode Island	687	690	911	4581	4745	4678	5788
Boise, Idaho	659	772	651	4995	4810	4881	5552
Boston, Massachusetts	561	585	908	4900	5002	5230	6045
Bozeman, Montana	912	983	1096	6549	6345	6993	8521**
Buffalo, New York	633	641	1032	5528	5752	5800	6822
Burlington, Vermont	782	789	1088	6553	6736	6584	7514
Butte, Montana	923	1088	1048	6819	6734	6683	8272
Cairo, Illinois	196	269	539	3252	3543	3708	3909
Canton, New York	756	767	1160	6819	6971	7002	8020
Charles City, Iowa	645	729	1024	6452	6360	6752	7588
Charleston, South Carolina	109	77	242	1674	1749	1733	1769
Charlotte, North Carolina	201	177	428	2709	2817	2961	3120
Chattanooga, Tennessee	230	197	415	3032	3133	2974	3118
Cheyenne, Wyoming	833	939	995	5837	5875	6174	7466
Chicago, Illinois	562	470	845	5109	4980	5246	6077
Cincinnati, Ohio	299	347	676	3972	4462	4351	4684
Cleveland, Ohio	503	533	930	4848	5169	5371	6155
Columbia, Missouri	287	410	694	4114	4405	4597	4922
Columbia, South Carolina	140	116	301	2161	2209	2301	2364
Columbus, Ohio	390	432	778	4461	4778	4891	5398
Concord, New Hampshire	739	757	1011	6400	6355	6332	7353
Concordia, Kansas	393	490	735	4329	4398	4908	5315
Dallas, Texas	146	132	267	2063	2093	2247	2256
Davenport, Iowa	499	479	893	5345	5270	5718	6289
Dayton, Ohio	433	453	744	4840	5076	4787	5264
Denver, Colorado	575	676	800	4554	4573	5073	5874
Des Moines, Iowa	510	552	890	5369	5357	5825	6384
Detroit, Michigan	589	534	973	5298	5450	5691	6490
Devils Lake, North Dakota	1018	992	1323	8880	7739	8694	9970
Dodge City, Kansas	476	494	688	4139	4323	4646	5035
Dubuque, Iowa	592	558	958	5814	5725	6152	6790
Duluth, Minnesota	906	940	1265	7887	7379	7945	9443
Eastport, Maine	862	884	1110	6364	6155	6612	8520**
Elkins, West Virginia	529	467	763	4794	5072	5019	5697
El Paso, Texas	287	334	282	2520	2397	2383	2428
Ely, Nevada	917	1155	—	6446	6438	—	—
Erie, Pennsylvania	572	574	973	4920	5126	5407	6273
Escanaba, Michigan	867	937	1262	6808	6838	7290	8771*
Evansville, Indiana	275	339	620	3944	4182	3968	4244
Fort Smith, Arkansas	242	226	397	2937	2862	3054	3147
Fort Wayne, Indiana	524	531	818	5364	5599	5321	5925
Fort Worth, Texas	165	146	217	2099	2110	2121	2148
Fresno, California	314	447	316	2319	2479	2199	2334
Galveston, Texas	65	24	78	1044	941	1016	1016
Grand Junction, Colorado	599	708	672	5069	4401	5046	5548
Grand Rapids, Michigan	587	523	964	5446	5382	5827	6535
Green Bay, Wisconsin	792	739	1125	6650	6434	6903	7825
Greensboro, North Carolina	303	249	474	3393	3470	3319	3529
Greenville, South Carolina	225	183	446	2866	2807	3185	3380
Harrisburg, Pennsylvania	506	413	803	4569	4693	4880	5375
Hartford, Connecticut	599	589	887	5357	5465	5303	6036
Hatteras, North Carolina	231	258	465	2164	2514	2316	2571
Havre, Montana	742	925	1169	6627	6841	7557	8700
Helena, Montana	776	978	1004	6094	6572	6615	7898
Houston, Texas	64	28	65	1185	1116	1157	1157
Huron, South Dakota	760	804	1092	6931	6401	7167	8004
Indianapolis, Indiana	366	390	756	4493	4658	4855	5298
*Kansas City, Missouri	300	423	691	4043	4190	4644	4956
Kewanee, Illinois	485	485	884	5126	5122	5524	6139
Knoxville, Tennessee	228	224	496	3173	3277	3460	3670
La Crosse, Wisconsin	680	765	1033	6661	6163	6611	7322
Lander, Wyoming	865	997	1028	—	7178	6694	7947

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with nine exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, Sioux City, and Jackson, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill.; Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, and H. M. Ludlow, Box 1368, Jackson, Miss., respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table Concluded on page 104]

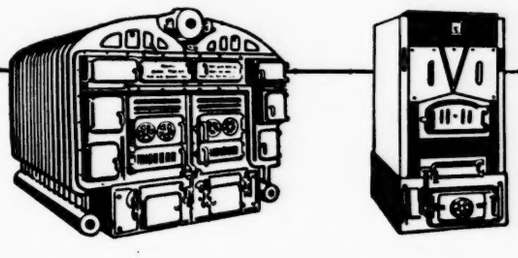
"Looks like we're ALL for Cast Iron"

When professionals discuss the best type of boiler for any job, they agree upon *cast iron.* Leading architects, engineers and contractors know that it's a recommendation they can make with confidence. For experience has taught them these important facts about cast-iron boilers:

They're a sound investment in long-term satisfaction . . . they resist corrosion and rust indefinitely . . . they are easily installed, maintained, replaced . . . they deliver high efficiency, low operating cost.

The professionals also agree on the leadership of H. B. Smith Boilers in the cast-iron field . . . for every commercial, industrial, institutional and residential installation . . . for all fuels and fuel-burning methods. Again — experience has confirmed their judgment.

Write today for your free catalogue of H. B. SMITH *Cast-Iron* Boilers.



H.B. Smith

CAST-IRON BOILERS

THE H. B. SMITH CO., INC., WESTFIELD, MASS. Offices and Representatives in Principal Cities

Degree-Days for March, 1946 (Concluded)

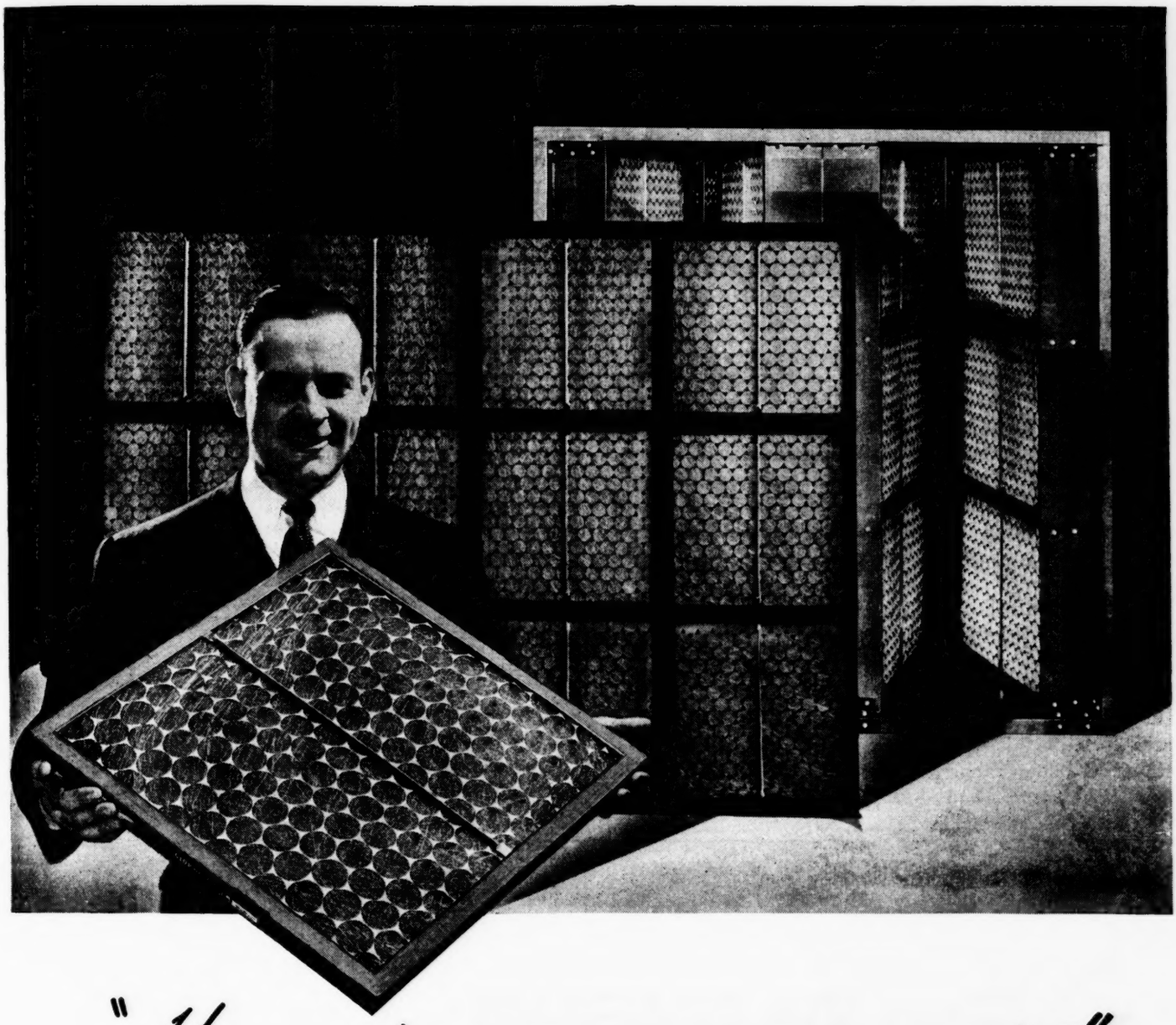
HEATING AND VENTILATING'S 19TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

CITY	MARCH			CUMULATIVE, SEPTEMBER 1 TO MARCH 31			HEATING SEASON[1]
	1946	1945	NORMAL	1945-46	1944-45	NORMAL	NORMAL
Lansing, Michigan	632	579	1035	—	5928	6237	7048
Lewiston, Maine	800	842	1093	6643	6532	6625	7707
Lincoln, Nebraska	425	527	840	4751	4820	5483	5999
Little Rock, Arkansas	203	215	353	2746	2866	2733	2811
Livingston, Montana	804	879	967	5734	5832	5985	7205
Los Angeles, California	248	336	239	1173	1224	1255	1504
Louisville, Kentucky	252	291	589	3615	3941	3916	4180
Lynchburg, Virginia	372	302	564	3693	3843	3707	3980
Jackson, Miss.	159	118	—	2043	1977	—	—
Macon, Georgia	141	95	260	2094	2051	2168	2201
Madison, Wisconsin	676	614	1054	6256	6096	6611	7429
Marquette, Michigan	845	833	1249	6788	6570	7164	8693*
Memphis, Tennessee	194	213	384	2865	2983	2854	2950
Meridian, Mississippi	148	125	245	2063	2125	2136	2160
Milwaukee, Wisconsin	703	643	1023	5883	5869	6208	7245
Minneapolis, Minnesota	696	784	1094	6924	6532	7044	7850
Modena, Utah	783	931	827	5436	5418	5591	6562
Montgomery, Alabama	110	82	208	1889	1745	1884	1884
Nantucket, Massachusetts	696	691	899	4585	4662	4811	5957
Nashville, Tennessee	198	234	477	3210	3382	3327	3507
New Haven, Connecticut	663	653	899	5091	5202	5129	5895
New Orleans, Louisiana	64	22	59	1105	955	1024	1024
New York, New York	475	453	837	4274	4437	4706	5347
*Nome, Alaska	1811	1537	1660	8757	7995	8886	14580**
Norfolk, Virginia	280	248	521	2785	3012	3104	3350
North Head, Washington	625	686	623	3794	3422	3755	5452**
North Platte, Nebraska	620	666	875	5025	5105	5681	6366
Oakland, California	417	465	363	2530	2426	2392	3143**
Oklahoma City, Oklahoma	280	300	465	2994	3103	3451	3613
Omaha, Nebraska	462	588	868	5132	5194	5633	6131
Oswego, New York	716	687	1060	5683	5819	5993	7088
Parkersburg, West Virginia	343	374	670	4012	4485	4371	4775
Peoria, Illinois	460	484	862	5219	5269	5535	6109
Philadelphia, Pennsylvania	421	388	756	3974	4168	4385	4855
Phoenix, Arizona	119	244	152	1467	1466	1405	1405
Pittsburgh, Pennsylvania	385	416	787	4285	4616	4734	5235
Pocatello, Idaho	800	919	843	5979	5819	5696	6655
Portland, Maine	789	819	1017	6393	6353	6105	7218
Portland, Oregon	541	588	558	4446	3399	3732	4469
Providence, Rhode Island	526	538	890	4730	4820	5206	6015
Pueblo, Colorado	618	666	732	4791	4784	4872	5514
Raleigh, North Carolina	258	208	446	2887	3038	3051	3234
Rapid City, South Dakota	727	880	1010	5675	5922	6150	7118
Reading, Pennsylvania	464	411	794	4388	4579	4876	5389
Red Bluff, California	363	488	—	2549	2425	—	—
Reno, Nevada	752	857	753	4844	4934	4902	5892
Richmond, Virginia	320	268	543	—	3423	3449	3695
Rochester, New York	668	660	1029	5678	5960	5854	6732
Roseburg, Oregon	553	604	546	3384	3359	3636	4428
Roswell, New Mexico	343	374	428	3095	3017	3304	3484
Sacramento, California	351	440	357	2386	2399	2393	2653
St. Joseph, Missouri	343	452	682	4390	4483	4803	5161
St. Louis, Missouri	252	356	657	3846	4155	4309	4585
Salt Lake City, Utah	649	788	722	5070	4537	4866	5555
San Antonio, Texas	111	45	74	1500	1482	1202	1202
San Diego, California	243	287	251	1226	1216	1350	1645
Sandusky, Ohio	546	499	915	4874	5152	5299	6208
San Francisco, California	366	409	353	2069	2055	2123	3264**
Sault Ste. Marie, Michigan	919	957	1314	7413	7373	7629	9285**
Savannah, Georgia	100	47	167	1540	1442	1490	1490
Scranton, Pennsylvania	557	530	893	5075	5447	5445	6129
Seattle, Washington	585	599	620	3563	3357	3917	4934**
Sheridan, Wyoming	808	935	1048	5973	6091	6837	8008
Shreveport, Louisiana	139	105	202	2003	2016	1938	1938
Sioux City, Iowa	576	703	967	5939	5776	6245	6898
Spokane, Washington	738	844	778	5278	5144	5485	6355
Springfield, Illinois	325	471	760	4457	5116	4951	5373
Springfield, Missouri	328	407	626	3891	4121	4149	4428
Syracuse, New York	656	639	1004	5702	5922	5984	6893
Tacoma, Washington	616	640	648	3881	3699	4086	5181**
Terre Haute, Indiana	311	372	663	4327	4504	4539	4872
Toledo, Ohio	573	540	905	5298	5644	5372	6077
Topeka, Kansas	311	420	682	4024	4162	4635	4969
Trenton, New Jersey	488	430	735	4325	4532	4450	4933
Utica, New York	1390	717	989	6610	6352	5955	6796
Valentine, Nebraska	669	788	980	5641	5937	6205	7039
Walla Walla, Washington	565	636	598	3949	4077	4274	4808
Washington, D. C.	357	329	694	3666	3911	4253	4626
Wichita, Kansas	357	420	648	3821	3941	4421	4673
Williston, North Dakota	844	986	1280	7858	7181	8238	9323
Winnemucca, Nevada	751	844	767	5177	5288	5411	6427**
Yakima, Washington	621	700	620	4591	4522	5053	5599

†Nome data are for February

*Includes August.
**Includes July and August.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.



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Air filtering, in many production processes, frequently makes the difference between profit and loss—between inspection approvals and rejects. Then air filters are "worth their weight in gold". Yet by using DUST-STOPS*, the advantages of filtered air can be obtained at both low initial and low maintenance cost.

The DUST-STOP is a replaceable-type air filter in which packs of adhesive-coated FIBERGLAS fibers provide an efficient medium for catching and holding most atmospheric and manufactured dusts.

DUST-STOP Air Filters are readily adaptable to the smallest or largest heating, ventilating or air-conditioning system—may be installed in custom-built or the complete, ready-to-assemble DUST-STOP steel frame cells that can be built up into filter banks *to handle any c.f.m. of air required.*

Once the filter bank is installed, maintenance is easy and economical—for replacement DUST-STOPS are readily available from authorized suppliers in every community.

Complete information on DUST-STOP Air Filters will be sent on request—See Sweet's Files for typical installation details or write: Owens-Corning Fiberglas Corp., Dept. 912, Toledo 1, Ohio. Branches in principal cities.

In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.

DUSTOP **AIR FILTERS**

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—a FIBERGLAS product

NEW CATALOGS

Vibration Control

A 4-page bulletin describing Rex "Super Service" Vibra-Sorbers for refrigerating and air conditioning machinery. Vibra-Sorbers are sections of flexible extensible tubing which are said to prevent the transmission of vibrations through piping systems connected to moving machinery.—*Chicago Metal Hose Corp., Maywood, Ill.* 1

Domestic Oil Heaters

Catalog No. 10 under the title "A Catalog of Warm Floors," describes a line of oil-fired room heaters which are said to direct heat toward the floor and thus maintain even temperatures throughout the room. Various sizes and models are illustrated, together with specifications for their use. Catalog No. 14 describes oil-fired hot water heaters for the home.—*The Coleman Co., Inc., Wichita 1, Kans.* 2

Vibration Control

A series of four bulletins describing the application of vibration eliminators for machinery of various types. Bulletins are divided by subject such as: fan and motor bases, rubber-in-shear unit isolators, natural cork unit isolators, cork and rubber rails. Installation photographs and data are included.—*Vibration Eliminator Co., 10-28 47th Ave., Long Island City 1, N. Y.* 3

Filters, Pressure Leaf and Cartridge

New catalog illustrates the Refiner, a pressure leaf type filter for clarifying and polishing, and the company's well-known line of cartridge type filters for industrial, marine, and general service. The Refiner breaks the tightest emulsion, and removes oil from condensate down to .01 ppm.—*Blackburn-Smith Mfg. Co., Inc., Hoboken, N. J.* 4

Fan Blade Catalog

The difference between NEMA and NAFM performance ratings of propeller type fan blades is part of the data in the Torrington Mfg. Co.'s new Airistocrat fan blade catalog. Both types of rating are shown side by side for each of the fans which it is practical to use either in free air (NEMA) or under pressure (NAFM). The book is edited to provide anyone needing data on propeller type fan blades with a valuable reference work.—*Torrington Mfg. Co., Torrington, Conn.* 5

Relief Valves

Publication 4150, a 28-page catalog, describes the Cochrane multiport safety relief valve, its applications in relief of steam, air, gas, gasoline and oil vapors, water, etc. Sizing data on relief valves which include capacity and pressure rise tables are included.—*Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia 32, Pa.* 6

Tap Extractors

Listed in a new descriptive folder are ten tap extractors designed for the quick and easy removal of broken pipe-threading taps. This new folder emphasizes a complete range of extractor sizes for standard hand taps, for machine screw taps, and now for pipe taps ready for delivery from stock.—*The Walton Co., 94 Allyn St., Hartford, Conn.* 7

Generator Case History

A new 12-page booklet (No. ID-46-1H) entitled "Facts and Figures" issued by the Industrial Division of York-Shipley, covers the case history of an installation of a Steam-Pak Generator, manufactured by York-Shipley in a prominent dairy. Printed in green and black, the booklet shows how the Steam-Pak Generator handled the varying load requirements for high pressure process steam and low pressure heating steam, by furnishing steam at a steady pressure regardless of the demand. One of the features of the piece is a series of fuel comparison charts with which the costs of oil for heating purposes are compared with other fuels.—*Industrial Division, York-Shipley, Inc., York, Pa.* 8

Axial Flow Fans

The 11th edition of Aerovent's 51-page data book and catalog of Airfoil "Macheta" fans contains sections on aerodynamics, fan characteristics, operation, and general ventilation. Rating tables, fan laws and handy reference data complete this 2-color descriptive booklet.—*Aerovent Fan Co., Piqua, Ohio.* 9

Dust Control Booklet

Bulletin No. 270-A, a new Roto-Clone dust control booklet, contains many installation photographs, tables, charts and a discussion of a simplified procedure for designing a Roto-Clone exhaust system. Also included is an explanation of pressure relationships in an exhaust system and methods of measurements.—*American Air Filter Co., Inc., First and Central Ave., Louisville, Ky.* 10

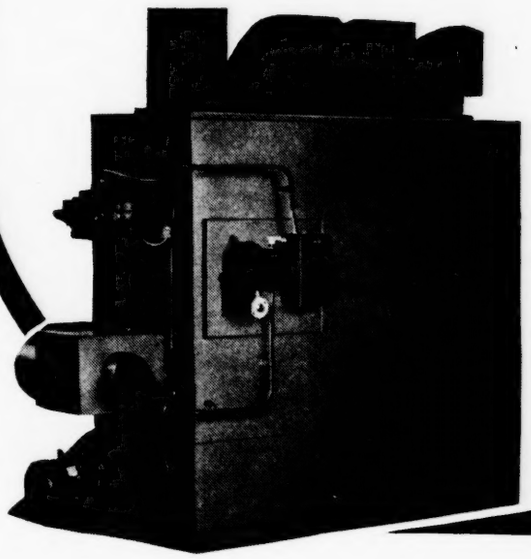
Electronics Digest

Recording the latest developments in electronics at work, the new "Electronics Digest" (B-3726) which includes articles on Stratovision, Mot-O-Trol, fluorescent lighting, electrolytic tin plating, X-Ray inspection, and electrostatic air cleaning, is announced by the Westinghouse Corp. The 50-page booklet, including an explanation of the electron theory and of basic electronic devices, is designed to keep management groups abreast of modern trends in the use of electronics, and is published quarterly.—*Westinghouse Electric Corp., Box 868, Pittsburgh 30, Pa.* 11

Resistance Welding

Describes what resistance welding is, and illustrates the principal types of resistance welds such as spot weld, projection weld, seam weld and others. Applications are illustrated. Bulletin GES-3388, 12 pages.—*General Electric Co., Schenectady, N. Y.* 12

SIMPLIFIED CONSTRUCTION MEANS LOWER OPERATING COSTS!



Airtherm Direct Fired . . . Space Heater

Simplified construction of primary and secondary heating surfaces to accomplish low internal resistance was of prime importance in the design of the Airtherm Direct Fired Space Heater. The result is low power cost to you without the sacrifice of over-all efficiency.

Bulletin 801, describing this new Airtherm Heater in detail will be sent you on request.

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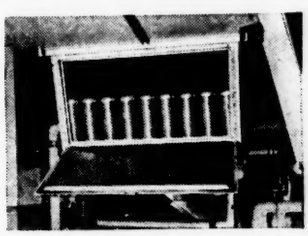
You save fuel, power and equipment when you save conditioned air

All ventilation is essentially the dilution of stale, odorous and contaminated air. Fresh air for that purpose can be obtained by purifying already conditioned return air with Dorex *activated carbon* Air Recovery Equipment. This can be done at a cost materially lower than the cost of drawing in and conditioning the quantities of outdoor air otherwise required.



Dorex activated carbon canisters in air duct.
One of the 30 installations in the Criminal Courts Building, New York

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For full information and quotations on Dorex Equipment, call the nearest District Representative or write Dept. E-1.

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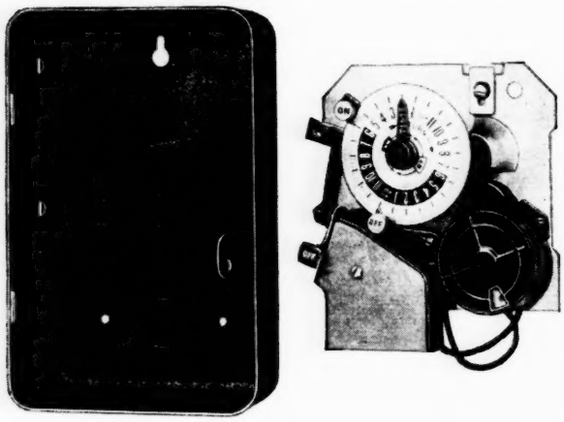
The INTER-MATIC

TIME SWITCH is Well Engineered

DESIGN FEATURE No. 2

MECHANISM EASILY REMOVED



The entire mechanism can be removed by simply loosening one screw and sliding down the locking member.

WITH THE MECHANISM REMOVED

—The case can be mounted easier.

—The functioning of all parts can be checked at a glance.

—All parts can be replaced with a minimum of inconvenience.

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Safety Heads

Catalog No. 46 describes the capacities, characteristics and applications of rupture discs for pressure vessels and fluid lines.—*Black-Sivalls & Bryson, Inc., Kansas City 3, Mo.* 13

Stainless Steel Bellows

A new 12-page booklet (No. SSB-46) entitled "C.M.H. Stainless Steel Bellows." Contains diagrammatic cross-section views and information concerning the use of stainless steel bellows as equalizers, compensators expansion joints, flexible connectors, for flow control vapor and steam traps, thermostatic instruments, electrical controls and other applications.—*Chicago Metal Hose Corp., Maywood, Ill.* 14

Low Temperature Blowers

New bulletin on overhead blowers for low temperature cooling contains up-to-date, engineering information in tables of data on: How to select the proper refrigerant—how to select type of coils—how to select unit for a specific room temperature—what blower to use for refrigerators—recommended air velocities for specific products is given in detail.—*Rempe Co., 340 N. Sacramento Blvd., Chicago 12, Ill.* 15

Pumps

Condensate and boiler feed pumps for high pressure are described in tables of characteristics and sizes in a 4-page folder.—*Whittington Pump & Engineering Co., 245 So. Meridian St., Indianapolis 4, Ind.* 16

Copper Alloy Welding

"Welding and Brazing of Copper and Copper Alloys" is the title of a 32-page handbook of procedures and materials which contains three principal divisions. In the introductory section properties of materials and processes are given. In the second section of the book each of the common copper alloys is discussed individually. Then the applicability of each of the welding and brazing processes to the alloy is explained. A third and final section is devoted to welding and brazing materials for copper and copper alloys, and the general plan of treating each material separately is followed.—*C. E. Phillips & Co., 2750 Poplar St., Detroit 8, Mich.* 17

MAY, 1946

TO OBTAIN COPIES OF TRADE LITERATURE listed in this issue, circle on the list below the publications wanted, using the item number at the end of each review; print your name and address, mail to

Editor, HEATING AND VENTILATING,
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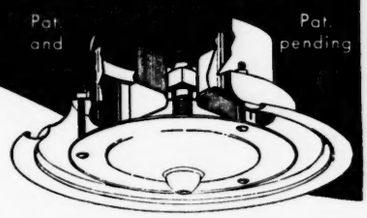

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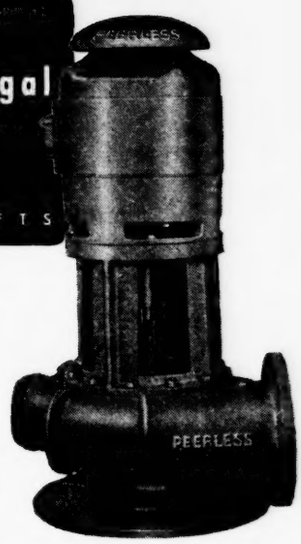

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100 to 5000 g. p. m.
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• Peerless Vertical Centrifugal Pumps are intended for general pumping purposes. • They are built in both the Close-Coupled and Submerged types. The Submerged type is furnished with either top or bottom suction. Direct connected electric motor, steam turbine or engine drive, either direct or through right angle gear. • These pumps are successfully applied to sumps or drainage or wherever it is necessary to move large quantities of water at comparatively low lift. • Installation space is reduced to a minimum, of paramount importance in industrial installations . . . Extremely economical to operate.

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. . . Defies Georgia's Summer Heat for Customers of Large Macon STORE* . . . With A-P VALVES Controlling the Cooling System.

Mr. H. L. Brown of Brown-Starr Electric Co., Macon, inspects store cooling system.

TEN YEARS of highly dependable service in controlling the cooling system of a leading chain store in Macon, Georgia, is credited to A-P Refrigeration Valves by Macon's Brown-Starr Electric Co. who services the installation.

***Writes* BROWN-STARR'S Mr. H. L. Brown:**
"The job shown in the picture is the installation at a large store here in Macon. I have used A-P Valves on this job to control the cooling system for the last ten years. In the fifteen years I have been using A-P Valves, I have always found them to be very satisfactory."

Because they afford a wide range of adaptability, every standard A-P Refrigerant Valve can be used on Air Conditioning, Commercial Temperature, and Low Temperature installations without need for special attachments or for changing valves. This permits the use of one standard A-P Valve to fit a wide variety of applications.

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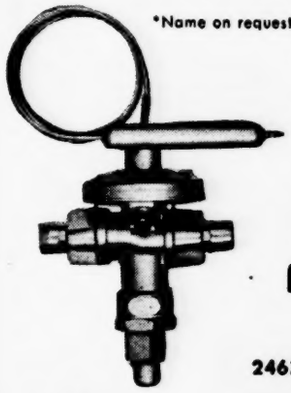

A-P Model 215 Thermostatic Expansion Valve. Capacity—up to 6 tons Freon and 12 tons Methyl Chloride.

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DEPENDABLE *Refrigerant Valves*

Stocked and Sold by Good Refrigeration Jobbers Everywhere.
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Wagner Used Bronze Bearings in 1891.

They were the best bearings obtainable at that time. We continued to use them until the more compact and powerful modern driven machines imposed higher bearing loads on our motors.

In 1927 Wagner Pioneered the Bimetal Bearing Which Permitted Higher Bearing Loads.

This Bimetal bearing had a steel outer shell for strength and a high tin babbitt lining for a superior bearing surface. Destruction tests by belting together two identical motors, one equipped with bronze bearings, the other equipped with Bimetal bearings, showed that the Bimetal bearings resist seizure and operate at lower temperatures than bronze bearings.

World War II Necessitated Increased Research.

Tin became scarce... Modern Bronze bearings were again considered but finally a Bimetal bearing having a lining of antimony lead babbitt containing a small percentage of tin was selected for its superior performance.

PROVE IT TO YOURSELF!

Take a Standard Wagner Diamond Bored Fully Finished Bimetal Bearing—

You will find that it is not necessary to line ream or otherwise machine it if you install it in an endplate in the following manner.

1. Use a snug fitting mandrel or motor shaft.
2. *Press it in.*
   Don't beat it in as this usually causes buckling and upsetting of the end of bearing, either of which necessitates line reaming.
3. Assemble motor.
4. The motor will be ready to run.

Bimetal Bearings for Undersize Shafts.

These Bimetal bearings are available unbored for use on undersize shafts within reasonable limits.
They should be line reamed to fit the desired size.

These Bearings Are Available for Immediate Delivery.

Genuine Wagner motor parts are available at 325 authorized service stations displaying the sign pictured at the left.

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M46-10B

Wagner WE Electric

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WHAT READERS SAY

The Solar House

Editor, HEATING AND VENTILATING:

I have read, with interest, the paper on "The Solar House: A Research Report" in the March issue and wish to compliment F. W. Hutchinson on his very ingenious and straightforward approach to the solar problem.

The author has been quite careful to forestall, insofar as possible, misinterpretation of the results. There is one important point, however, which is not stressed in this article; namely, the fact that the house consisted of one room only so that all heat received on the sun exposures is useful in making up for the loss on the shaded sides. This is not a normal building design. Frequently, rooms having large sun exposures are overheated and require the admission of outdoor air for cooling at a time when heat is required, for example, on rooms having only a north exposure. The fact that these are single rooms is not mentioned in the article and is not quite clear from the photographs but was confirmed in discussion with Prof. Hutchinson.

The report further states: "...these houses are identical except that the orthodox house has glass in 12% of its wall area while the solar house has 22½% of wall area in glass." This is not a complete statement as the photographs show that the glass in the orthodox house consists of a number of small panes whereas large sheets are used in the solar house. The effect of mullions on shading and transmission has been recognized but I also have some reason to believe that the transmission of equal areas of glass made up of small panes would exceed that of one equivalent large pane when using two layers of glass with an air space and a sealing material at the edge. I doubt if the percentage effect on this experiment is significant but, if I am correct in my surmise, the effect would be quite appreciable in a building having a large percentage of glass.

Philadelphia, Pa. *Charles S. Leopold.*

Professor Hutchinson comments that both of the points brought out by Mr. Leopold are very well taken and will be the subjects of additional investigation.—*The Editor.*

. . . Since the Last Issue

Ellis G. Powell, with the **C. A. Dunham Co.** for the past 22 years has been advanced from head of the development section to chief engineer with headquarters at the Michigan City plant. Mr. Powell graduated from Purdue University in mechanical engineering. Prior to coming with the Dunham Co. in 1924, he had served the Pullman Co. in its machine and tool design division, was an engineer with the Sheet Steel Products Co. and was assistant manager of the Young Pump Co., acquired by Dunham in 1924.

John G. Schutz is back with **Research Products Corp.,** Madison, Wis., after five years in the armed forces where he served as a captain with the First Cavalry Division. Mr. Schutz had previously been with Research Products for two years prior to the war and is rejoining this organization as a sales manager.

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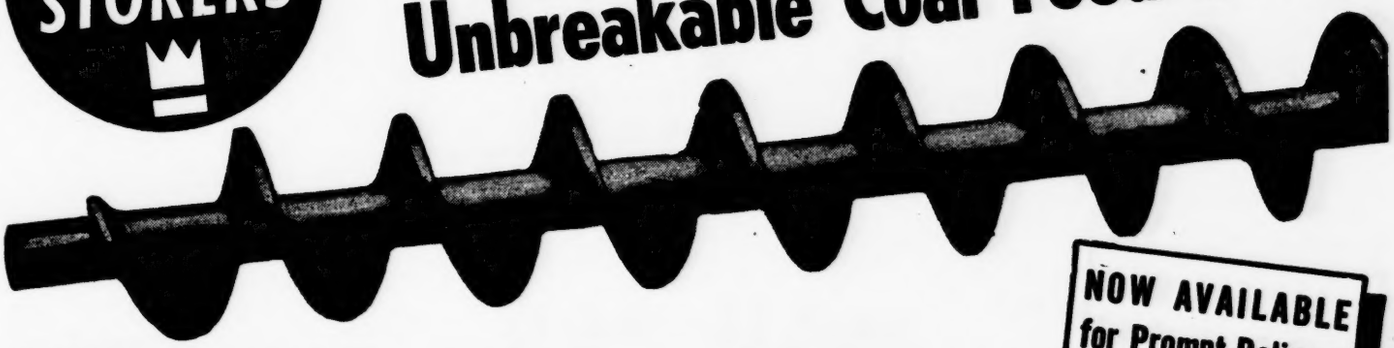
The CROWN Unbreakable Coal Feed Screw



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Are You Getting All the Humidification That's Coming to You?...

If not, check your system for excess slime and lime scale. If you find that water lines and spray jets are clogged, try this easy, economical Oakite corrective:

Circulate solution of recommended Oakite material to remove slime. Then drain, rinse out tank and refill with fresh water.

Periodically add a small quantity of Oakite Airefiner No. 52 to fresh make-up water. This remarkable chemical additive inhibits slime growth; holds lime scale in suspension. Lines and jets remain fresh and clean.

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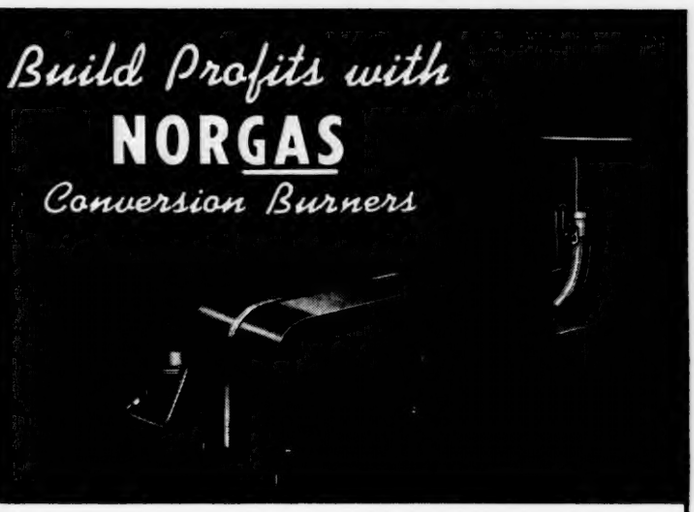

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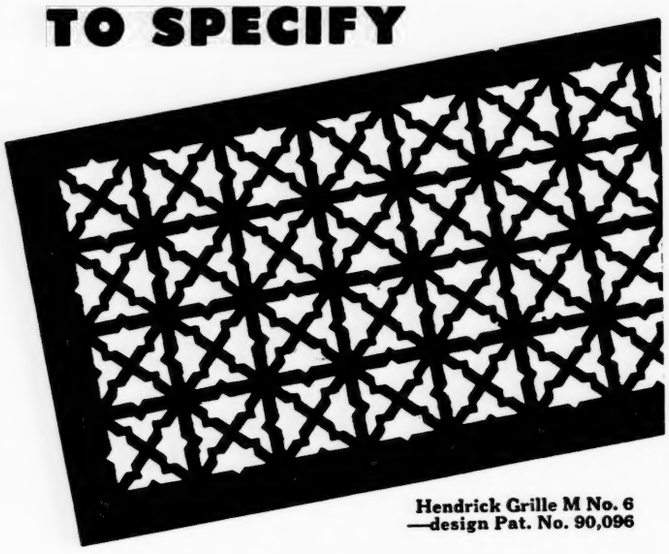

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Dependability in such important details of manufacture and materials, has long been a keynote of Hendrick policy. Grilles are rugged and strong, made of heavy-gage metals – sizes are accurate, produced in flat or curved types and segments – perforations are clean-cut and free from imperfections – and varied designs are available in many commercially rolled metals. Write, on your letterhead, for your copy of the 194-page Hendrick Grille Handbook, which illustrates over 100 standard and exclusive designs.

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Purchase of a new plant which will triple Canadian manufacturing facilities was announced by **Minneapolis-Honeywell Regulator Co.** Located at Leaside on the outskirts of Toronto, the new factory, which was purchased from Small Electric Motors (Canada), Ltd., already is in production, and currently is employing 250 persons on the manufacturing and assembly lines. Built at the beginning of the war for the production of gunsights and other fire control instruments for the Canadian, British and American navies, the plant was purchased complete with machine tools which are suited for the manufacture of the company's line of heating, ventilating and air conditioning control instruments. Under direction of **W. H. Evans**, general manager for Canadian operations, the new plant will make and assemble the major share of all of Honeywell's controls for the Canadian market. Manufacturing and sales operations formerly located at the company's older facilities at 117 Peter Street, Toronto, were terminated at the end of March and the transfer to the Leaside location fully completed.

W. H. Evans

Promotion of **Lloyd MacGann** to branch manager of the Baltimore office of Minneapolis-Honeywell was announced by Arnold Michelson, New York resident vice-president.

The engineering and research staffs of the **Nordstrom Valve Co.** and **Edward Valves, Inc.** have been pooled to give impetus to their product development program. Both affiliated with the **Rockwell Mfg. Co.** of Pittsburgh, the two companies for years have maintained extensive engineering and laboratory staffs carrying out independent programs. In a recent meeting at the Edward plant, executives of the sales, engineering and research staffs worked out a long-term program which keeps the advantages of separate operations with extensive exchange of technical design and research data and summaries of investigations.

Lyle C. Harvey, president, **Bryant Heater Co.**, Cleveland, Ohio, announces the appointment of **O. Fred Habegger** as manager of advertising. A native of Pittsburgh, Mr. Habegger is a graduate of the University of Pittsburgh where he also pursued graduate studies in heating and air conditioning. Before coming to Bryant, he was connected with the sales departments of Standard Register, Dayton, and the Equitable Gas Co. of Pittsburgh.

The **National Radiator Co.** has purchased the **Pullman-Standard Car Co.** plant at Middletown, Pennsylvania. The plant will fabricate steel boilers for industrial and domestic purposes, pressure vessels, heat exchangers and other industrial products, formerly made at the firm's Lebanon plant.

Charles C. Allen, recently discharged after serving as Chief Warrant Officer, U. S. Navy, is now a field engineer for the **Henry Valve Co.** of Chicago, according to a recent announcement. Mr. Allen attended the University of Dayton and the YMCA Technical College of Dayton. Before the war he was a refrigeration and air-conditioning service engineer for Frigidaire Division of General Motors and a field engineer for Alco Valve Co. He will cover the Ohio territory, including adjacent parts of Pennsylvania, New York, Kentucky, and West Virginia.

C. C. Allen

"Yes. Heat where you want it—"

REZNOR
Gas unit heaters

1. Suspended—gas fired
2. Comfortable heat
3. Circulated heat
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Propeller fan and blower types. Nine sizes of each.

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ORIGINATORS OF ELECTRONIC CONTROLS FOR HEATING SYSTEMS

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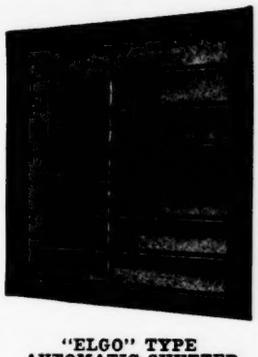
Nationally Known Automatic Shutter

The Elgo is known from coast to coast as "tops" in automatic shutters because of its distinctive features, such as: Tight-fitting, weather-stripped louvers. Swivel-type joints—no wear or rattle. Unusual sensitiveness to air currents. Made in sizes 10"x10" to 72"x72"—or rectangular.

Write for catalog and prices.



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Front View (Closed)

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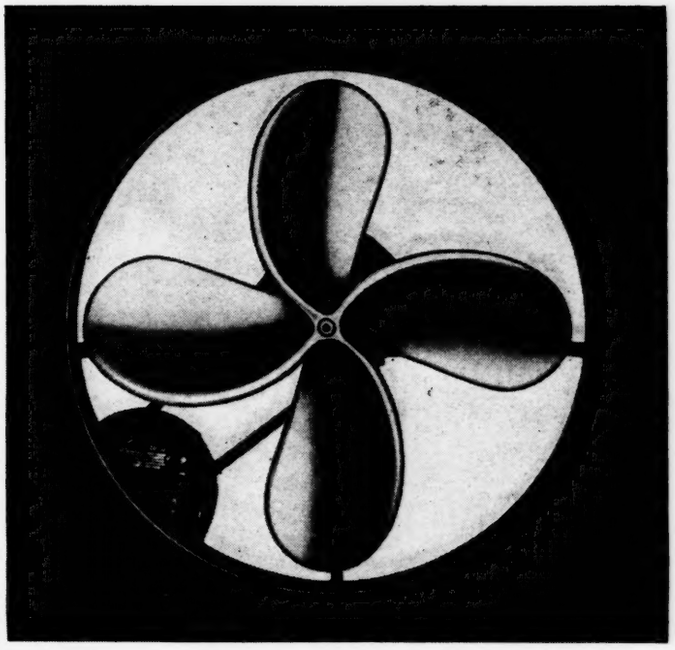

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Dependable, silent operating exhaust unit, with one piece aluminum alloy fan blade, cast with curve at the back edge of the fan blade for quiet operation. Design eliminates dead centers, eddy currents and air friction, permitting air to flow uniformly over the entire surface of the blade for the most positive performance attainable.

Stilphen Attic Ventilating Fans are easy to install, economical to operate and efficiently perform against low static pressure. Fan and motor are mounted in welded steel frame drilled to facilitate installation. Hinged motor mounting provides proper belt tension under all starting and operating loads.

Fan louver opens from air pressure created by the fan, and closes to keep rain, insects and cold drafts from entering the home.

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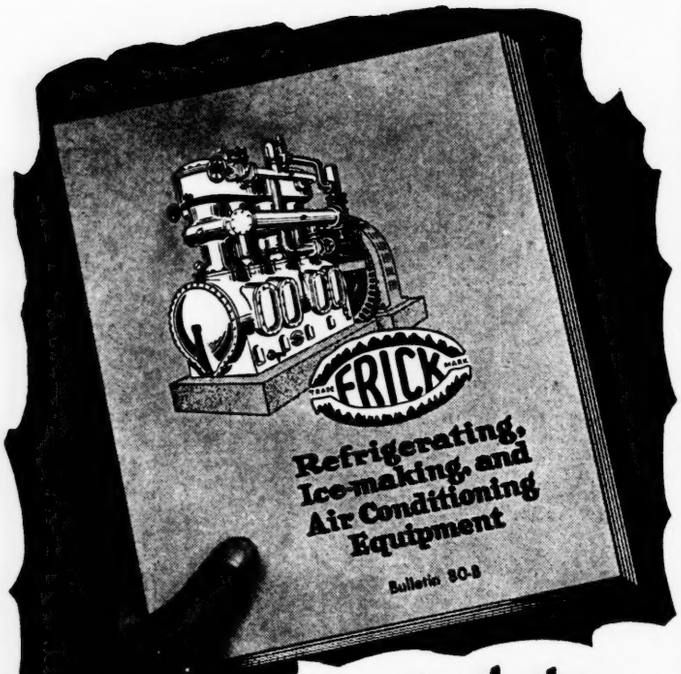

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This new 32-page Catalog, containing over 150 photographs, diagrams, and tables, gives the very latest data on cooling systems of all commercial and industrial (not household) types.

The Bulletin is printed in three colors, in full letter size, and has a durable cover. As shown below, it is one of the most informative books ever published on refrigerating machinery.

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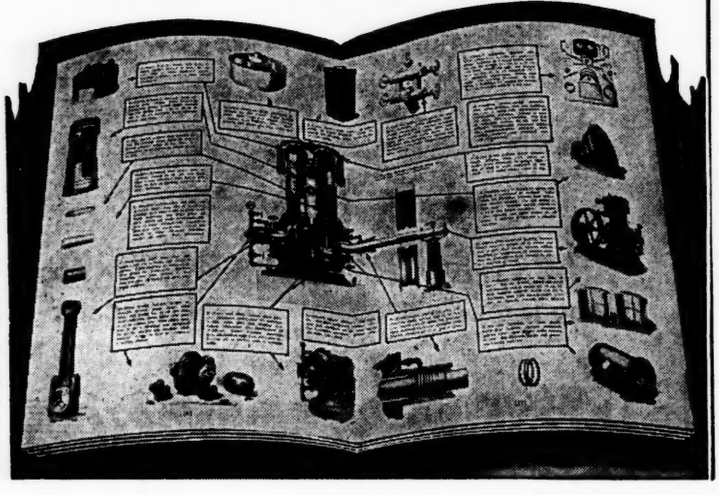
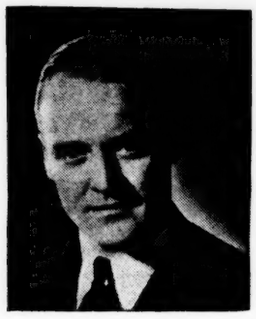


The board of directors of the **Johnson Service Co.**, 60-year-old Milwaukee manufacturer of automatic temperature control systems, elected officers for the ensuing year, on April 2nd. Re-elected were **Harry W. Ellis,** chairman of the board; **Joseph A. Cutler,** president and general manager; and **Oscar G. Ward** and **Maxwell F. Rather,** vice-presidents. **Richard J. Murphy,** formerly secretary and assistant treasurer, was elected secretary and treasurer. New officers named were **J. R. Vernon,** assistant secretary, and **Louis V. Zachary,** assistant treasurer. Activities of the company have been largely converted to peacetime production, the apparatus being sold and installed by 36 direct branch offices in the United States and Canada. The automatic control of air conditioning and radiant heating installations in commercial buildings, schools, hospitals, factories, institutions and larger residences is expected to constitute the principal market for Johnson products, together with special applications in connection with industrial processes.

C. S. Davis, Jr. has been named vice-president and general manager of the **Norge-Heat** division of the **Borg-Warner Corp.** Also announced was the appointment of **J. W. Oswald** as sales manager of Norge-Heat. Mr. Davis joined Borg-Warner's Norge division in 1937 as a refrigeration test engineer. In 1939 he transferred to the Norge

J. W. Oswald



C. S. Davis, Jr.

heating and conditioning division, predecessor unit to Norge-Heat, as assistant to the manager. He became manager in 1940. Mr. Oswald has been associated with distribution of home heating and plumbing equipment and household appliances since 1930. He joined the Norge division in 1934 as field representative and in 1945 was appointed sales engineer in the automatic transmission division, which position he held until the present.

The **Perfex Corp.** of Milwaukee, Wis., manufacturer of automatic temperature controls and industrial engine radiators, has announced the formation of a Canadian subsidiary to be known as **Perfex Controls Limited,** with headquarters at 73 Simcoe Street, Toronto 1, Ontario. The officers of the newly formed subsidiary are **J. K. Luthe,** president; **C. E. Lewis,** vice-president; **E. G. Spall,** vice-president; **V. R. Tate,** secretary; **A. L. Eastcott, treasurer;** and **J. F. Van Lane,** assistant treasurer.

York-Shipley, Inc., announces the recent appointment of **Ralph Gibbs,** B.S. in electro-chemical engineering, as director of research. Mr. Gibbs has contributed many important treatises on refractory problems to leading lay and scientific journals. His experience covers more than 25 years of direct service to heating and associated industries and includes a long prior association with the York Corp. as chief chemist and consulting engineer.

E. J. McFadden, recently returned after more than three years' service in the U. S. Army, has been appointed sales manager for General Electric water heaters, it has been announced by J. R. Poteat, manager of the Range & Water Heater Divisions of the **General Electric Co.**

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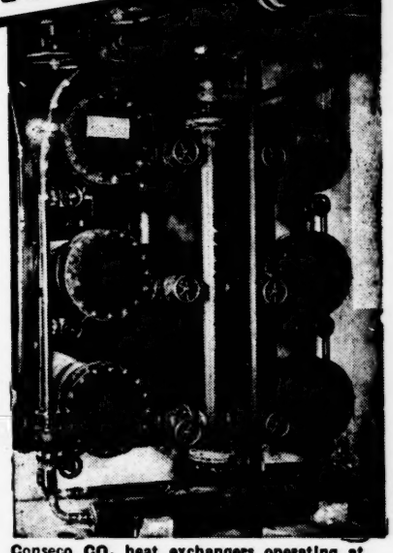
Air Conditioning HEAT EXCHANGERS

All types of heat exchangers retubed, repaired, rebuilt. FAST, expert service. Days, nights, holidays. Quick delivery on new condensers and coolers. Twenty years' specialized experience designing, fabricating and servicing heat exchangers assure sound design, quality construction and economical operation with any type refrigerant. Engineering assistance gladly furnished. Write.



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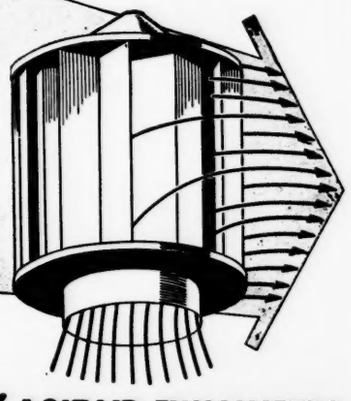

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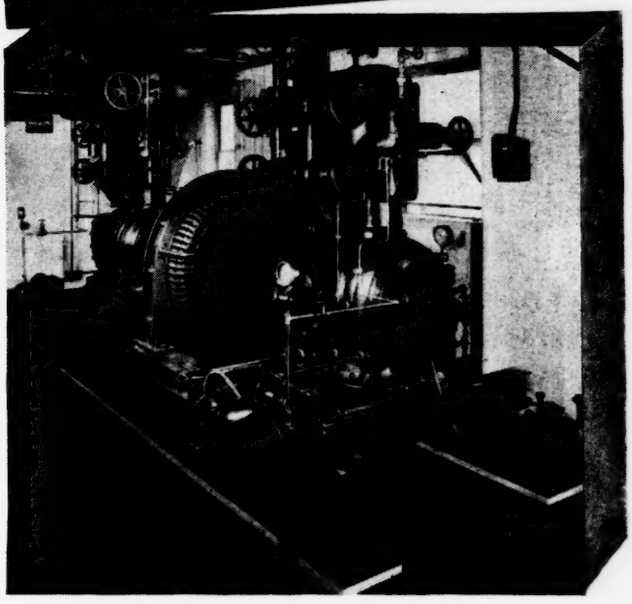
21-E

KORFUND VIBRATION CONTROL FOR *Compressors* And All Other Air Conditioning Equipment



Korfund Vibration Controlled installation on the fourth floor of a large department store.

Air conditioning equipment is installed to provide comfortable working and living conditions. In consequence, Vibration Control is a "MUST," where machinery noise and vibration are most irritating and undesirable. Korfund Vibration Control units reduce noise and vibration transmission so effectively that persons in the building cannot tell when the equipment is operating.

On *all* air conditioning installations, Korfund does a two-fold job. First, it eliminates the disturbing operating noise. And second, Korfund prevents vibration transmission that can be both annoying and dangerous to the building structure.

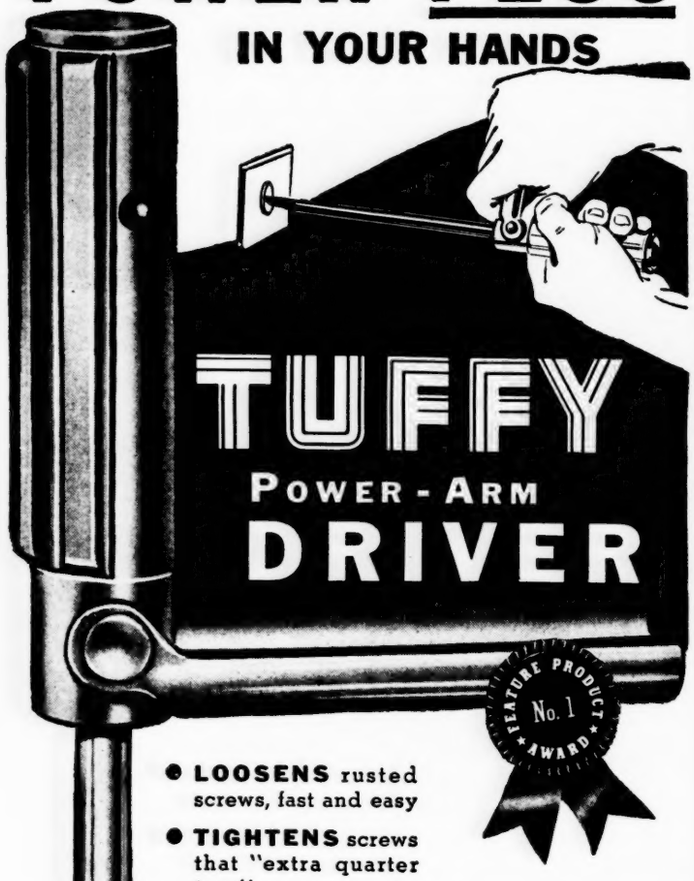
The Korfund Co., Inc., is now sole distributor of Armstrong Standard Density Vibracork. Write for details.

Korfund offers you Engineering Service with over forty years' experience in Control of Vibration. Write today about your vibration problems.

KORFUND
VIBRATION CONTROL

THE KORFUND COMPANY, Inc., [illegible] 32nd ST., LONG ISLAND CITY 1, NEW YORK

POWER PLUS
IN YOUR HANDS



- **LOOSENS** rusted screws, fast and easy
- **TIGHTENS** screws that "extra quarter turn"
- **DRIVES** as regulation screw driver with power-arm closed.

Winner New Product Award among 118 new products in "Mill and Factory" Magazine.

Rusted, frozen screws are no longer an everyday problem since Tuffy Power-Arm Driver was designed. Patented power-arm allows for "two-handed" driving, brings to bear POWER *PLUS* for *loosening* tight screws and *tightening* screws so they stay put. In a split-second power-arm handle snaps shut and Tuffy becomes a regulation screw driver. Mechanics everywhere save time and tempers with easy-to-use, powerful Tuffy. Order today through your jobber.

OTHER TUFFY DRIVERS

Power-Arm Driver available in two standard sizes with SOCKET DRIVER.

Also available in three standard sizes of PHILLIPS DRIVER.

KIT OF 3 TUFFYS

Tuffy is available in three sizes; 5" x 1/4", 6" x 5/16" and 8" x 3/8". **$6.85**

Kit of all three "regular" Tuffy drivers at no extra cost.

SWALLOW AIRPLANE CO., INC.
900 Lincoln Street, Wichita 1, Kansas

Paul Warburg and **Bernard Steiert** have been named representatives for **Walsh Holyoke Steam Boiler Works, Inc.**, of Holyoke, Mass., and **Alloy Fabricators**, of Perth Amboy, N. J., at new headquarters at 345 Madison Avenue.

Barber-Colman Co., has announced the appointment of three new representatives for its automatic controls and air distribution products. **The Chet Adams Co.**, Greensboro, North Carolina, now represents Barber-Colman in that area. Barber-Colman's Florida representative is the **Clark Equipment Co.** of Clearwater. In Syracuse and the up state New York area the Barber-Colman representative is **Frederick W. Chadwick.**

Herbert Livingston Laube has been elected president of **Remington Corp.**, Syracuse, manufacturers of packaged air conditioning equipment. With Carrier Corp. since 1927, Mr. Laube was an export executive there 12 years, becoming vice-president of Carrier International Division in 1935. In January of 1942 he became vice-president responsible for the company's engineering, research and new product development, the position from which his resignation was effective April 15. He has been identified with the engineering and sales phases of the refrigerating and air conditioning industry since 1924. Remington Corp., successor to the company founded by George W. Remington in Wilmington, Del., in 1872, specialized in packaged air conditioning from 1937 until the war.

H. L. Laube

Donald French, vice-president, has again been placed in charge of the engineering division of Carrier Corp., replacing Herbert L. Laube, who has resigned. Mr. French joined Carrier in 1930. He directed research and development, which are the principal activities of the engineering division, from 1931 to 1941. He was elected vice-president of the corporation in 1934. Since 1941 he has been head of the staff division and will continue in that position in addition to directing the work of the engineering division.

The Trane Co. announces the opening of a new office in Oklahoma City under the management of **R. W. Schulte.** Mr. Schulte has been in engineering work in design of heating and air conditioning systems for the past 25 years. He was with Albert Kahn in Detroit from 1926 to 1931, practiced engineering in Oklahoma City from 1932 to 1942, and most recently worked as a mechanical engineer on construction for the government. For part of this period he also held the position of Assistant Chief Mechanical Engineer for Graham-Anderson, Probst & White, architects in Chicago, Ill. Assisting Mr. Schulte as sales engineer is **S. S. Webb,** engaged in government work for the Navy in Houston, Texas, during the past four years.

The company also has announced the appointment of **P. R. Omohundro** to the staff of their Salt Lake City office. Mr. Omohundro is a native of Colorado. He has been associated with various companies in the heating field since 1924, first in Denver and since 1930 in Salt Lake City. His primary function in the Salt Lake branch will be trade and industrial contacts in that territory. Also announced is the association of **Joe E. Myers** with Trane's Philadelphia office.

L. J. Wing Mfg. Co., New York, N. Y., manufacturers of heating, ventilating, combustion equipment and turbines, announce the appointment of **Harang Engineering Co.**, 840 Lake St., San Francisco 18, as representatives for Northern California. Edward A. Harang, until recently a U. S. Navy officer, heads the firm and will be joined by his brother, Richard A. Harang, as soon as he is released from the U. S. Navy.

Steering a STRAIGHT COURSE IN THE STOKER BUSINESS

If you want to get into the stoker business in the BEST WAY, sell a stoker with a proven record of performance over a long period of years . . . a stoker praised by thousands of satisfied users, built by an experienced Stoker manufacturer, a 79-year-old company that knows how to help its dealers win profits.

AGAIN "Stoker Sales are Blowing a Gehl."

GEHL STOKERS

are well-known in the domestic, commercial, and industrial field for economical, trouble-free performance. The friendly "family" relationship between Gehl and its dealers encourages steady growth and continually growing sales and profits.

Domestic and industrial models now available.

FIND OUT about the extra values offered in Gehl Stokers, and the fine program of dealer cooperation. WRITE today for literature and details.

GEHL BROS. MFG. CO.

Dept. BE-860. West Bend, Wisconsin

Established 1867

A GEHL WINS FRIENDS WHEREVER IT GOES

WANTED!

Distributorship for reputable line of

AIR-CONDITIONING EQUIPMENT and ROOM COOLER UNITS

What have you to offer a well-rated Baltimore firm, now specializing in commercial, industrial and residential heating equipment sales and service?

Write Box No. 510, HEATING AND VENTILATING, 148 Lafayette Street, New York 13, N. Y.

SOLENOID OPERATED VALVES

FOR AUTOMATIC and REMOTE CONTROL

AIR • GAS • STEAM • LIQUID

A wide range of electric; thermostatic; and mechanical valves for all control needs. Carefully engineered to handle your problem. Write or wire today—we believe we can help you.

VALVES FOR ALL PURPOSES

CLARK COOPER COMPANY

327 Market St., Palmyra, New Jersey

Economical THERMOSTAT SETS

For

NATURAL and MANUFACTURED GAS

Finely engineered, field proved packaged sets for compact inventory and convenient installation. Ideally adaptable to gas-fired boilers, floor furnaces, conversion burners and warm air furnaces.

Set includes type K-3B two-wire gas valve, T-70 Metrotherm, transformer and 30 feet of cable.

ADAPTABLE TO L. P. GASES

100% shut-off is assured by the additional installation of an MR-2 electro magnetic thermovalve with 26-R Series pilot burner.

Write for Catalog 52B and Manual FI-101.

GENERAL CONTROLS

801 ALLEN AVENUE GLENDALE 1, CALIF.

FACTORY BRANCHES: PHILADELPHIA • ATLANTA • BOSTON • CHICAGO • DALLAS KANSAS CITY • NEW YORK • DENVER • DETROIT • CLEVELAND • PITTSBURGH HOUSTON • SEATTLE • SAN FRANCISCO • DISTRIBUTORS IN PRINCIPAL CITIES

14—2

PRESSURE, TEMPERATURE, FLOW, ELECTRICAL AND LEVEL MEASURING INSTRUMENTS

UNITED STATES GAUGE

6 out of 10 manufacturers of original equipment specify U. S. G.

DIVISION OF AMERICAN MACHINE AND METALS, INC.

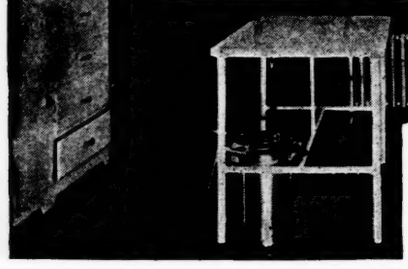
SELLERSVILLE, PENNSYLVANIA (4)

DEMUTH

Draftless

AIR DISTRIBUTOR

The only Distributor with the patented curved-vane construction which imparts a draftless turbulent motion to the air . . . the Distributor which effectively mixes room air with conditioned air . . . the Distributor which speedily establishes a uniform temperature WITHOUT DRAFT!



Quick Deliveries of STAINLESS STEEL ALUMINUM GALVANIZED IRON OR ENAMELED AIR DISTRIBUTORS

CHARLES DEMUTH & SONS

MINEOLA (LONG ISLAND), N. Y.

The Allen-Bradley Co. of Milwaukee, Wis., manufacturers of electric controlling apparatus, announces that their Boston office has been moved to larger quarters at 55 Oliver St. The new location combines warehouse and office facilities. M. H. Hallenbeck remains as district manager supported by Charles M. McCoombe.

Frank M. Urban has been appointed merchandise manager of the mechanical goods division of **United States Rubber Co.** Mr. Urban began his career with United States Rubber in 1929 as a salesman of mechanical goods in Chicago. In 1935 he became assistant sales manager in Chicago. Four years later he was transferred to the company's general offices in New York, and in 1944 was appointed assistant merchandise manager, the position he held at the time of his new appointment.

The **Taylor Instrument Co.**, has announced the appointment of **N. B. Nichols** as director of its research division. He succeeds Dr. H. L. Mason who resigned to accept the professorship of Mechanical Engineering at Iowa State College, Ames, Iowa. Mr. Nichols has, for the past four years, been associated with the Radiation Laboratory, Cambridge, Mass., a subsidiary of the Massachusetts Institute of Technology, where he was in charge of a group that pioneered in developing numerous mechanisms required in automatic gunfire control. This outstanding laboratory was headed by Dr. L. A. DuBridge of the University of Rochester and developed numerous forms of radar equipment. Before the war Mr. Nichols spent two years with the Taylor Research Division. The Research Department is undergoing considerable expansion. Two physicists, **Dr. Carlton W. Miller**, and **Dr. William A. Mersman**, both of the Radiation Laboratory, will come to Rochesterr soon after May 1. **Walter G. Countryman**, former U. S. Army Captain, returns to the Research Department after four years of military service.

N. B. Nichols

Leon R. Ludwig, manager of the **Westinghouse Electric Corp.**, Motor Division, announces the appointment of **W. D. Ligon** as works manager of the new Buffalo plant into which the division is moving from East Pittsburgh, Pa. During the time necessary to completely shift the division's operations from Pennsylvania, Mr. Ligon will act as resident manager of the Buffalo plant. Since December, 1943, Mr. Ligon has been manager of manufacturing in the Motor Division with headquarters in East Pittsburgh, Pa.

Dr. Harold J. Rose, vice-president and director of research of **Bituminous Coal Research, Inc.**, has announced the appointment of **William S. Major** of Philadelphia, Pa., as development engineer for the national research agency of the bituminous coal industry. After 20 years of service with American Engineering Co., manufacturers of industrial stokers, Mr. Major will be responsible for promoting various BCR research projects that have progressed far enough to justify commercial trial or use. One of his immediate duties will be to promote wider use of BCR-designed overfire air jets as smoke-prevention devices, especially in the stationary field.

Ilg Electric Ventilating Co., Chicago, Ill., has appointed **E. J. Stone** manager of the Detroit office. **Capt. W. L. Hochschild** has become associated with the Chicago branch office of ILG as a sales engineer. **John D. Briggs** has been assigned to the ILG branch office in Philadelphia, Pa. **William S. Gorham** has been appointed sales engineer in the ILG branch office in Los Angeles, Calif. The company now has 43 offices in principal cities.

B. P. Spann, advertising manager of the **Gardner-Denver Co.**, Quincy, Ill., has returned to the company after service of more than thirty-eight months in the Navy.

Allan T. Shepherd Co. sales force has been enlarged to include the following mechanical engineers: **John D. Hamilton**, formerly connected with Slaughter, Saville and Blackburn, Consulting Engineers of Richmond, is working out of the Richmond office and covering Virginia. **Caxton H. Tichenor**, for several years in the Engineering Department of the Glenn Martin Company of Baltimore, now has headquarters in Greensboro, North Carolina, and is covering the greater part of the State of North Carolina. **Christy W. Hansen**, formerly with The Dow Chemical Company of Midland, Michigan, now has headquarters at Greenville, South Carolina, and is covering the State of South Carolina and the extreme western part of North Carolina. **Allan T. Shepherd, Jr.**, formerly with the Virginia State Highway Department before entering the U.S.N.R., will work out of the Richmond office in the capacity of sales engineer.

Richard S. Sawyer has been named assistant general manager of purchasing and traffic for **Rheem Mfg. Co.**, and will make his headquarters in the New York office. He has been with the company since January 1941. During the war Mr. Sawyer was in charge of steel purchases for Rheem's 18 plants engaged in war production. He was purchasing agent and traffic manager for Globe Hoist Co. in Philadelphia prior to joining Rheem.

Water heaters and space heaters for the mass Mexican market to burn kerosene and butane are among products Rheem will make in that country in cooperation with Mexican associates. A new company, to be known as **Rheem de Mexico, S. A.**, is in process of formation and will start construction of a factory at Tlalnepantla, an industrial suburb of Mexico City.

John R. Halpin has been named appliance sales representative in upper New York state for Rheem. His headquarters will be in Rochester. Recently discharged from the Army, he previously had been with American Radiator Co. for nine years, doing sales work in the New York metropolitan area.

Robert F. Couch, who worked for **Hendrick Mfg. Co.**, Carbondale, Pa., from 1936 until the time he entered the Army in 1942, has returned to the firm as assistant to Trowbridge A. Warner, sales manager.

Joseph M. Perrone has been appointed director of research by **Watson-Standard Co.**, Pittsburgh, Pa. For the past three years he had been doing research and development work on protective coatings at Mellon Institute of Industrial Research.

Getting Personal

F. P. Jung

Francis P. Jung—*(Recirculating Spray Booth Exhaust*—page 62) was born and raised on a farm near Fredericksburg, Texas. After he received his BS in civil engineering at St. Edward's University, Austin, Texas, he worked for the Industrial Hygiene Division, Texas Department of Public Health. In August, 1941, he was commissioned in the Reserve Corps of the U. S. Public Health Service and assigned to the State of Maryland as engineer for the Division of Industrial Health. At the present time he is on terminal leave from the U. S. P. H. S., and has joined the Tennessee Department of Public Health, Nashville, Tenn., as principal industrial hygiene engineer.

Kling
ROTARY SHEARS
DO MANY TYPES OF WORK
DOES ALL THIS WORK FOR YOU
1 CUTS STRAIGHT LINES
2 CUTS RINGS-SMALL OR LARGE RADII
3 CUTS CIRCLES
4 MAKES FLANGES
5 CUTS INSIDE HOLES WITHOUT CUTTING IN FROM EDGES
6 JOGGLES & OFFSETS
7 CUTS ODD SHAPES
8 BEVELS OF ANY ANGLE
9 CUTS REVERSE CURVES
10 BEADS & CURLS
ALL WITH Hairline PRECISION

Yes, and With Hairline Precision

Rapid operation . . . Hairline Accuracy . . . the use of Kling Rotary Shears marks the latest development in cutting mild steel, and sheet metal, up to 1-inch with amazing savings in time, labor, and production costs.

For exacting projects (see illustration at the right), no single unit of metal-working equipment does so many different things so cleanly and efficiently as does the Kling Rotary, pictured above.

In metal working plants, automotive, aviation, home appliance, and other industries, where work of this character is being done, — this machine is held in high regard for its versatility and economy of operation.

This great usefulness is the result of half-a-hundred years of engineering experience which prospective buyers, with reason and respect, applaud.

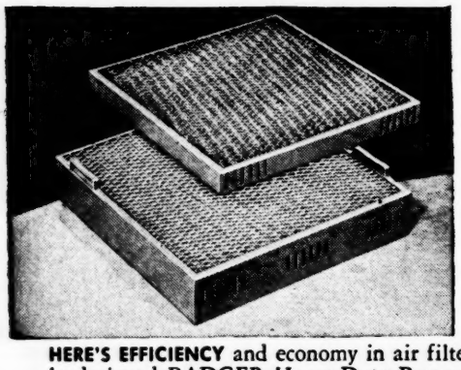
Send Today for Bulletin No. 245 which will give you specific facts, and specifications. No obligation involved. Users of heavy equipment of Kling Rotary Shears' class will receive a copy of this Bulletin promptly, on request.

KLING BROS. *Engineering Works*

1322-HV No. Kostner Ave., Chicago 51, Illinois

EXPORT DEPT. 1111 South Ferry Building, New York 4, N. Y.

EFFICIENT ECONOMICAL
AIR CLEANING
WITH THIS
BADGER *Heavy Duty*
PERMANENT INDUSTRIAL FILTER



★ GREATER CAPACITY
★ IMPROVED FILTERING
★ REDUCED COSTS

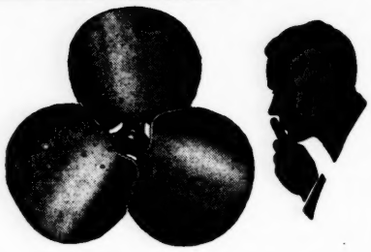
HERE'S EFFICIENCY and economy in air filtering — an especially designed BADGER Heavy-Duty Permanent Filter for extra heavy duty and industrial service. It gives you measurably improved air cleaning, lower resistance, greater capacity to hold dust—plus reduced maintenance costs. And the BADGER Heavy-Duty Permanent Filter *lasts longer!* In two sizes — 2" and 4".

Write for complete catalog and prices.

Badger CORPORATION
331 EAST BROWN ST., MILWAUKEE 12, WIS.

Meier Nu-air
TRADE MARK REGISTERED

Quiet Props



IMPROVE FAN PERFORMANCE

Produced under license from The Torrington Manufacturing Company.

Yes, Meier Nu-Air Quiet Props . . . precisely designed and sturdily constructed, will sell any air motion unit. Near mirror finish aluminum blades are insulated from the cadmium plated spider and hub for smooth, quiet performance. All Nu-Air propeller blades are static balanced and guaranteed to be accurate. Available in sizes 10" to 54" and from 11° to 34° pitch.

To improve the performance of your ventilating equipment, use Nu-Air Quiet Props. We will he happy to send prices and technical data. Write for Bulletin No. 2100.

Meier ELECTRIC & MACHINE CO.
3525 E. WASHINGTON STREET
INDIANAPOLIS, INDIANA

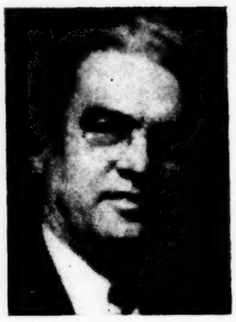
(Concluded from page 100)

ENGINEER DIES

Clyde R. Place designed mechanical and utility equipment for many noted buildings.

Closing a long and prominent career as consulting engineer and designer of mechanical, electrical, sanitary and heating systems for such famed buildings as Grand Central Terminal and Rockefeller Center, Clyde R. Place died on March 28.

• **BIOGRAPHICAL.**—He was born at Mount Upton, N. Y., September 18, 1877. After attending Wyoming Seminary, Pa., and Fredonia Normal School, Fredonia, New York, he entered Massachusetts Institute of Technology and in 1902 graduated with a B.S. degree in engineering.



C. R. Place

He came to New York, and in 1904 he was placed in complete charge of design and supervision of all the mechanical, electrical, sanitary and heating systems for the Grand Central Terminal Improvements.

Through the years the versatility of Mr. Place in all phases of engineering manifested itself in the great variety of projects which he planned and designed. His works include the following notable structures: Rockefeller Center, National Gallery of Art, National Archives Building, Maximum Security Disciplinary Barracks of Camp Cooke, California, Allegheny General Hospital, Waldorf Astoria Hotel, Metropolitan Life Insurance Company, Elgin Gallery of the British Museum of London, Peking University, Peking, China.

During World War II, his engineering organization was engaged exclusively in war work, including the design of camps, training centers, port facilities, government housing, industrial projects and consultation with many branches of the Armed Services.

In 1939, Mr. Place was cited by Mayor F. H. LaGuardia for his public service to the city's housing and building program which included a leading part in the codification of regulations and standards governing heating, ventilation, plumbing, power and elevator systems for the construction industry.

SUNSHADE

The sun deflecting window feature of the new Chevrolet plant in Los Angeles described and illustrated in the March HEATING AND VENTILATING was designed by the office of Donald B. Parkinson of Los Angeles, and not by Albert Kahn Associated Architects and Engineers, Inc. The latter firm was consultant on the project, Mr. Parkinson the principal.

Washington News

(Concluded from page 51)

not required as a part of the emergency proposals to handle the existing housing shortage, it is hoped that the House will take sufficient time to fairly examine its many complex and frequent obscure provisions as well as its overall extent."

OPA Crippled?

Brightest fireworks in Washington during April was the House revolt against OPA, which would be virtually crippled if the 11 amendments added to the OPA extension measure were also approved by the Senate. This, however, is considered unlikely. Although the Senate is no more partial to OPA than is the House, it seems certain that President Truman would veto any measure that throws price control out of the window at this time. A compromise measure is considered more likely, with modified controls continuing for another year, as requested by administration leaders.

Of interest to readers of this column who have pending projects in the apartment field is the likelihood that rents will soon be permitted to join the upward price parade. Congress hesitates to touch off so explosive a topic, but with other prices admittedly on the move, it is becoming most difficult to find any logic in holding rents at levels which Department of Commerce figures show are 24% below the 1929 level, when the cost of living index was only 1% higher than it is today.

Proponents of higher rents are already laying the groundwork, and it is likely that in continuing controls through 1947, higher ceilings will be permitted.

Export Bans Tightened

To halt the flow of scarce products overseas, the Office of International Trade has announced the addition of a large number of commodities for which individual licenses will be required if the value of shipments exceeds $50 for certain countries and $25 for others. Included in the list are house-heating boilers and warm air furnaces, house-heating convectors, domestic conversion oil burners and oil-fired boilers, coal stokers and parts, gas-fired burners and parts, space heaters, except electric; thermostatic elements, pilot, power; unit heaters and parts, warm air registers and grilles, and warm air pipe and fittings.

INDUSTRIAL DEGREE-DAYS
March, 1946

City	55F Base	45F Base
Baltimore, Md.	143	19
Buffalo, N. Y.	337	104
Chicago, Ill.	265	67
Cleveland, Ohio	221	56
Detroit, Mich.	290	83
Indianapolis, Ind.	125	28
New York, N. Y.	203	41
Philadelphia, Pa.	164	25
Pittsburgh, Pa.	139	27
St. Louis, Mo.	83	16

Keeps rust out— keeps heat in

B-H NO. 1 INSULATING CEMENT

A special rust inhibitor, in this insulating cement, keeps metal surfaces free from corrosion. No rust can form—even when the cement is allowed to dry out slowly on cold equipment.

The basis of B-H No. 1 Cement is nodulated *black* Rockwool. Although applied with water, the nodules remain unchanged — insuring full insulating efficiency. This cement withstands temperatures up to 1800° F. under the most humid conditions.

It can be stocked without breakage or loss, is easily applied even by an unskilled laborer, and is fully reclaimable when used at temperatures not exceeding 1200° F.

In *every* way B-H No. 1 Insulating Cement is ideal for maintenance work, especially for valves, fittings and irregular surfaces, large or small, and as a finish over blanket and block insulations.

JOBBERS are preparing to supply this easily-applied, cost-reducing product. It will pay you to investigate. Baldwin-Hill Co., 580 Klagg Avenue, Trenton 2, N. J.

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THERMAL INSULATION PRODUCTS